

DISCOVERY

A Monthly Popular Journal of Knowledge

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NOVEMBER, 1933

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ON A HOUSEBOAT IN KASHMIR
(see page 348).

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Notes of the Month.

THE latest discoveries of the East African Archaeological Expedition, led by Dr. L. S. B. Leakey, must rank as the most important for many years in the study of early man. The Kanjera skulls which the expedition has brought back are the oldest authenticated remains of *Homo sapiens* yet found and belong to the Middle Pleistocene Age. Of much greater antiquity is the Kaman mandible, also discovered by Dr. Leakey, which dates from the beginnings of the Lower Pleistocene Age or even from the Pliocene. X-ray examination of this discovery, however, indicates that although it belongs to the genus *Homo sapiens* it must rank as a new species: the Kanjera skulls show a distinct advance in the race as compared with Kaman man.

Of great importance are the stone implements found associated with both Kaman and Kanjera man; with the former was found a crude and roughly chipped pebble industry and with the latter a more fully developed type of hand-axe. Dr. Leakey points out that at Oldoway, another East African site, excavations have revealed a continuous evolution of the hand-axe culture, into which the two stages at Kaman and Kanjera have been found to fit. This strongly favours the view that East Africa was very near to the beginnings of this culture. As Mr. J. Reid Moir observes in a letter to *The Times*, Dr. Leakey's discoveries have proved the theory—to which until recently there was much opposition—that

early man was both of great antiquity and of world-wide distribution.

An International Conference to consider the protection of wild life in Africa is now being held in London. Its progress will be followed with the greatest interest by lovers of nature in all the countries concerned. Many species of wild life are in grave danger of extinction in Africa owing to indiscriminate hunting, to the tremendous traffic in trophies and, of course, to the inevitable disappearance of big game where man has settled. The problem was ably discussed by Major R. W. G. Hingston in *Discovery* two years ago, when he pointed out that even such familiar animals as the elephant, the giraffe and the zebra might share the fate of the dodo and the quagga unless adequate measures were taken to protect them. The solution clearly lies in the provision of national sanctuaries in which wild animals and plants may be preserved. If the Conference succeeds in securing co-operation to these ends between the administrations concerned it will have done an important work. A new International agreement is clearly called for.

The announcement that the discoveries made by Mr. M. E. L. Mallowan at Arpachiyah in Iraq have not been allowed to leave the country has caused some misgiving. This statement was made by Sir Edgar Bonham-Carter at the first meeting of subscribers to the British School of Archaeology in Iraq (Gertrude Bell Memorial). The Iraqi Government has expressed dissatisfaction with the allocation of the finds as between the expedition and the Baghdad Museum, although it had already been approved by the Director of Antiquities. In view of the importance of Mesopotamia in the history of civilization, no effort is likely to be spared to ensure that action taken by the Government shall not prejudice the future of excavations. In the meantime we fear that other bodies may follow the example of the British School and refrain from organizing expeditions to Iraq. A full account of Mr. Mallowan's discoveries, with some remarkable illustrations, will be published in *Discovery*

next month. The results of excavations at Arpachiyah, near Nineveh, have emphasized the homogeneity of the earliest inhabitants of Mesopotamia. The various sites are marked by hundreds of thousands of painted pottery fragments, and on these we must entirely depend for our knowledge. The traditions of the early peoples may now be followed through Crete to Mycenae on the West, and through Persia to Baluchistan on the east. Despite difference in the many types of painted pottery, all point to a fundamental unity of culture, which is borne out by the existence throughout of the Mother Goddess cult and the cult of the Bull.

* * * * *

A remarkable invention for rendering historic documents imperishable is likely to find a wide application. The process, which has been perfected by Mr. Everard Digby, involves the imprinting of platinum characters upon gold. It will thus be proof against decay, attacks by insects and other forms of damage to which paper and parchment are exposed. Sheets of gold, one four-thousandth of an inch thick are used, and a process of photography is employed, thus eliminating the possibility of error in copying manuscripts. A notable feature of the work is that photographs as well as text may be reproduced in fine detail. The expense of the new process will restrict its use to documents of permanent importance and it is not likely to take the place of paper for ordinary use. A portrait of Prince George has already been reproduced by this means and a copy of the Prince of Wales' Arms is being made. Among the first to take advantage of it for the reproduction of family records is the Duke of Norfolk, who is having a copy made of a document now in the British Museum which includes a miniature portrait.

* * * * *

The most representative collection of insects yet made in East Greenland has been brought back by the Cambridge Zoological Expedition which recently returned to this country after an absence of three months. Birds and mammals have also been studied, and the expedition's collection as a whole is expected to throw new light on many problems connected with the fauna of the Arctic. An interesting discovery is the fact that animal life is able to exist on the mountain tops which project through the ice-caps. On the west coast of Liverpool Land, near Scoresby Sound, flourishing colonies of insects and spiders were discovered in small patches of moss and lichen. A full account of the expedition will be contributed to *Discovery* by Mr. B. B. Roberts, who was in charge of

the scientific work, as soon as the material has been analysed.

* * * * *

"Make Life Easier: Install the Telephone" has often seemed to us to be a vaguely misleading piece of advice. So we welcome the invention of a system which, according to the Postmaster-General, is already resulting in greatly improved reception. Extensions to the Post Office Research Station have just been opened, and Sir Kingsley Wood marks the occasion with an article in the *News-Letter*, in which he reviews the latest developments. On all telephones, he says, there is usually a loss of upper and lower frequencies which prevents the natural voice from being heard in the receiving instrument. The recently perfected "zero system," however, enables the whole of the frequencies to be reproduced "so that at the receiving end there is reproduction of the voice exactly as it leaves the transmitter." We shall look forward to observing the effect of this innovation.

* * * * *

The following lines appeared in *Greece and Rome* for October apropos of the portrait of Vergil reproduced in the May number of *Discovery*, with a brief account by the late Professor Conway of the reasons for believing it to be authentic. The portrait shows, among other things, the carelessness in the poet's dress—in hair, in the adjustment of the toga, and in the cut of his shoes—which seems to be attributed to him by his friend Horace in *Sat.* 1. 3. 30. (The words in italics are to be said in a whisper.)

So, Vergil, that's your picture;
With flashing eyes and free.
[To save pedantic stricture
We spell you with an -e-.]

Glad we'd have been to know you,
And ask what Bavius did;
And could the Muses show you
The cave where Dido hid?

Your singing, master poet,
No centuries will stop;
But your hair—how should you know it?—
Was just a prison-crop.

Your looks they called ungainly,
—Some folk are hard to please.
But your toga very plainly
Is hunched across your knees.

Mæcenæ bade one meet you;
No Roman could refuse.
Who would not want to greet you?
But what appalling shoes!

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New Light on the Text of the Bible.

By Sir Frederic G. Kenyon, K.C.B., F.B.A.

Until the recent discovery of the Chester Beatty papyri our knowledge of the Greek Bible was mainly based on two incomplete manuscripts of the fourth century. The new material, now partly published in book form, throws valuable light on many textual problems, particularly those connected with the four Gospels and the Acts.

JUST two years ago the first public intimation was given of the discovery of a group of manuscripts of the Bible older than any (except a few small scraps) previously known. The publication of the first three parts of the *Chester Beatty Papyri** now places in the hands of scholars the means of estimating the importance and character of the discovery. The first part gives a brief description of the collection as a whole, with a specimen facsimile of each manuscript, and discusses certain bibliographical details common to all of them. The second and third give the complete texts, with textual apparatus and introduction, of the three manuscripts which contain portions of the New Testament. The others, which contain portions of the Old Testament and of the apocryphal Book of Enoch, will follow in due course.

Age of the Collection.

Of the collection as a whole the outstanding features of interest are its age and its form. Hitherto the basis of our knowledge of the Greek Bible has been the two great vellum manuscripts, the Codex Vaticanus and the Codex Sinaiticus, which are by common agreement among paleographers assigned to the fourth century. Both originally contained the entire Greek Bible; but the Vaticanus has lost nearly the whole of Genesis, about one-fifth of the Psalter, the last four-and-a-half chapters of Hebrews and the whole of the Pastoral Epistles and Apocalypse, while the Sinaiticus has the New Testament complete (with the addition of the books of Barnabas and Hermas), but has lost about three-fifths of the Old. Now we have, in the Chester Beatty collection, a group of manuscripts—fragments, it is true, but in most cases fragments sufficiently substantial to allow the character of the text to be discerned—containing portions of nine books of the Old Testament and ten of the New, most of which can be assigned with confidence to the third century, while one seems certainly to be as early as the middle of the second, and none is later than the fourth. Such material is bound to throw valuable light on the problems with which students of the texts of the Bible

have to deal. Bibliographically, the collection gives us much information as to a peculiar type of book, the papyrus codex. During the classical ages of Greek and Latin literature the papyrus roll reigned supreme, and in the Middle Ages, from the fourth century to the invention of printing, the vellum codex was equally dominant. There has already been evidence, from the discoveries of the last generation in Egypt, of an intermediate form, overlapping the end of the papyrus roll and the beginning of the vellum codex, in which the material was still papyrus but the form was the codex, or modern book form with quires and leaves. It has also been becoming clear that this form, if not originated by the Christians, was at any rate markedly favoured by them. In the third century pagan literature (according to the papyri discovered in Egypt) was still almost exclusively written on papyrus rolls; but Christian literature already shows a majority for the codex.

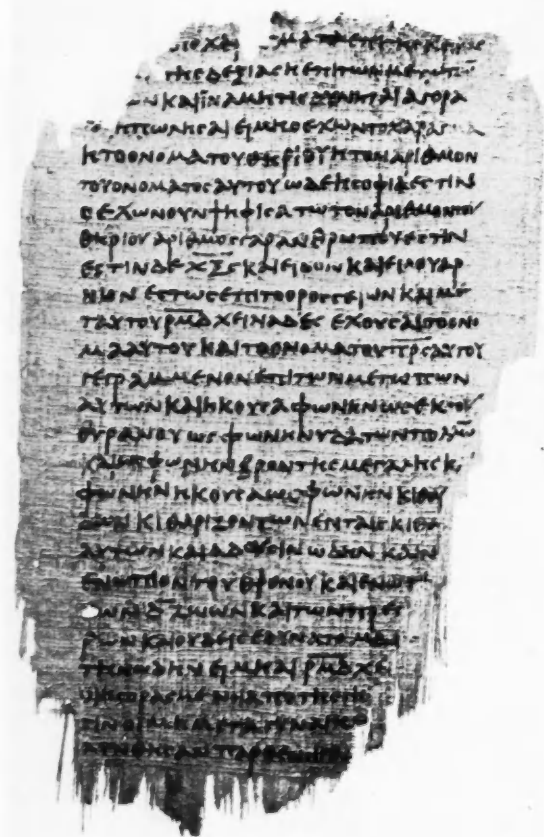
The Chester Beatty papyri emphatically confirm this conclusion. All are papyrus codices; they prove that this form was in use as early as the second century, and they give us examples of a third-century codex of the Gospels and Acts, and another of the Pauline Epistles. The great advantage of the codex over the roll was the greater amount of matter that it could contain. The roll could hold no more than the equivalent of a single book of Thucydides or a single Gospel; of a codex the contents were almost unlimited. Consequently, whereas at first the Gospels could only circulate as separate books in separate rolls, as soon as the codex was invented the four Gospels could be gathered together in a single book and presented as a unit; and of this we now have an example before us.

The Codex.

It is evident, however, that the codex was still, bibliographically speaking, in an experimental stage. The essence of the codex is that it consists of a number of sheets of material folded so as to form quires, which are then sewn together to form a book. In a modern octavo printed book, the standard form has quires of eight leaves or sixteen pages; and this form, or one with quires not much larger than this, was also common in the vellum codices of the Middle Ages.

**The Chester Beatty Biblical Papyri*. Description and Texts of Twelve Manuscripts on Papyri of the Greek Bible. Fasciculus I, General Introduction; Fasciculus II, The Gospels and Acts; Fasciculus III, Pauline Epistles and Revelation. By FREDERIC G. KENYON. (Emery Walker. 1933.).

But this size of quire was only arrived at as the result of experience. On the one hand it was possible to take a sheet of papyrus and fold it in the middle, so forming a quire of two leaves or four pages, which being joined to others gave a book formed of a number of small quires. At the other extreme you could take as many sheets as would suffice for your whole book, lay them on top of one another and fold them in the middle, thus giving you a book composed of a single enormous quire. Or, intermediately, you could form your quires of eight or ten or twelve leaves, as was eventually found to be the most convenient practice. The Chester Beatty collection gives examples of all these varieties. The Gospels and Acts MS. is formed of a number of single-sheet quires; but three or four of the others are examples of single-quire volumes, running to what one would think the very cumbrous extent of more than a hundred leaves, while others again have quires of ten or twelve leaves. By such



The Chester Beatty papyrus of "Revelation," written probably in the second half of the third century.

a method of trial and error was our modern form of book evolved.

Unquestionably the most important of the Chester Beatty manuscripts is that which contains portions of the Gospels and Acts, which is now published in the second part of the present series. When complete, it was a volume of 110 leaves, or 220 pages, measuring about ten by eight inches, written with a single broad column on each page, in a small but clear hand. Only thirty of these leaves are preserved, and some of these are only small fragments. Even, however, when only part of a column of writing is preserved, it is often possible to be assured from the parts extant or by a calculation of spaces, which of two alternative readings was contained in the manuscript; so that in result we have evidence for a very substantial portion of the text of these books. The books best represented are Luke and Acts. Of Luke there are seven leaves, and all but one of them are comparatively well preserved, lacking only a few lines at the bottom. Of Acts there are thirteen leaves, but less perfect. Of John there are two leaves, one nearly perfect, the other less so. Of Mark there are six leaves, but very far from complete; while of Matthew there are only small fragments of two leaves.

The Gospels and the Acts.

This manuscript is important, both because the four Gospels and the Acts are the most important books in the world, and because the textual problems relating to them are particularly intricate. The investigations of scholars, culminating in the work of Westcott and Hort about fifty years ago, established the fact that the very large majority of extant manuscripts of the New Testament represent a relatively late revision of the text, which appears to have originated (perhaps at Antioch in Syria) about the fourth century, and was adopted by the Byzantine Church, and thenceforward, with some progressive modifications, became the standard text of the Christian Church throughout the world. It was from late manuscripts of this class that the Greek New Testament was first printed; this was the "received text," and from this our Authorized Version was translated. Over against this there is a small group of early authorities, headed by the Codex Vaticanus, to which Westcott and Hort gave the name of *Neutral*, because they regarded it as (scribal errors apart) substantially uncontaminated and unaffected by editorial revision.

But besides these there were a number of authorities, also early in date and supported by quotations in the earliest Christian writers, and widely spread over the Christian world, which often differed (and sometimes

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very markedly) from both the Neutral and the Byzantine form; these Hort grouped together under the term *Western*, because the most outstanding representatives of this class were the Græco-Latin Codex Bezae and the earliest (African) form of the Old Latin translation. Within recent years yet another group has been identified, principally by Professor Kirsopp Lake and Canon Streeter, to which the name of *Cæsarean* has been given, because it is the type of text which Origen appears to have used during the later years of his life at Cæsarea.

Many Copies.

Now, therefore, that a manuscript has come to light which is perhaps a century older than the oldest of our existing manuscripts, the first question to be asked is, which of these types of text does it support? It is to be feared that no short or clear-cut answer can be given to this question. In the first place, the character of the text is not quite uniform throughout. This is neither an unprecedented not an unnatural phenomenon. Since all collected copies of the four Gospels descended from separate rolls of the four books, it might easily happen that the ancestors of the several Gospels were of different types; and experience shows this to have been the case. Many copies of the Gospels are known, in which the text of Matthew, Luke, and John is of the normal Byzantine type, while Mark preserves readings of an earlier character.

A particularly notable example of the mixture of texts is provided by the Freer Gospels at Washington, discovered in 1906, and dating perhaps from the fifth century, in which Matthew and the greater part of Luke are Byzantine in character, John and the first part of Luke are Neutral, the first five chapters of Mark are Western, while the remainder of Mark is Cæsarean. Scholars have now to satisfy themselves as to the character of the Chester Beatty papyrus, and it would be rash to prejudice their conclusions; yet it may be interesting to set out the results offered by the first editor as a basis of discussion.

In Mark the papyrus appears to be definitely more Cæsarean than anything else. Its closest affinity is with the Washington MS. just mentioned, and after that with the minuscule manuscripts and the Koridethi codex which are the primary authorities for this type. It is in much closer agreement with this group than with either the Neutral or the Western authorities; and as between those two it has more Western than Neutral readings. For Matthew there is not enough evidence to determine its character. In Luke the Cæsarean text has not yet been determined, and all that can be said is that the papyrus is definitely nearer



The oldest known MS. of the Bible, a second century papyrus codex of "Numbers" and "Deuteronomy."

to the Neutral type than to the Western, and that it has none of the more marked variants characteristic of the latter in this Gospel. In John it is almost equidistant between the two. In Acts it again leans predominantly to the Neutral side, and though it has a number of minor readings which are classed as Western, it has none of the more striking variants characteristic of this type.

It must therefore be concluded that the papyrus is not wholly either Neutral, Western, or Cæsarean; still less is it Byzantine. It does not establish any one of these types as superior; but it suggests some instructive deductions as to the early textual history of the Gospels. It shows that the Neutral text, though no doubt domiciled in Egypt (where both the Vatican and the Sinaitic MSS. appear to have been written), was not exclusively predominant there; and this conclusion is supported by the numerous small fragments of early papyrus MSS. that have been found in Egypt. It lends no support to the more striking variations found in the leading Western authorities, the Codex Bezae and the African Old Latin version; yet it has many minor readings for

which these are the principal witnesses, and which are not in the Neutral type. It proves that the Cæsarean type was known in Egypt at a date either contemporaneous with Origen or not much later, and therefore suggests that the type did not originate in Palestine, but may possibly have been brought thither by Origen himself when he removed from Alexandria to Cæsarea.

If speculation may be pressed further (and progress is only possible by the temporary formation of hypotheses, which must be tested by further investigation), it would seem that the papyrus belongs to a period when the main families of text were not yet formed. In the third century, and still more in the second, it is likely that various readings would be produced in large numbers. Copies of the Gospels were written in all parts of the Roman Empire to meet local demands, with little opportunity for revision and control. Copyists, besides the normal liability to mistakes in transcription, would be tempted to make alterations in the interests of lucidity, or of uniformity between the different narratives of the same events. Their object would be edification, not a punctilious preservation of the exact words of the original authors; and they might be glad to incorporate phrases or passages from various sources accessible to them. Only as the Church became more organized would the process of revision be taken in hand; and then not by a central authority, but by different local authorities in different parts of the world. And when bishops or scholars undertook the task of bringing order out of chaos, not all would set about it in the same way. Some, when confronted with a choice of various readings would choose the easiest or the fullest, or would combine both alternatives; others, with more of the mind and training of a scholar, would be inclined to think the less obvious or the shorter reading more likely to be that which the Evangelists wrote. So, in different parts of the world—in Palestine, in Syria, in Egypt, in Africa, in Rome—we may suppose local texts to have come into existence, which with every variety of intricate interchange in the course of the centuries produced the groups and families with which the scholar of to-day has to deal.

A Scholar's Work.

It would follow from all this that the Neutral text is less likely to be, what Hort held it to be, a text that has descended with little correction from the beginning, than a text scientifically constructed by a scholar from good materials. The Western, on the other hand, would appear not to be a single family at all. Under that head have been lumped together all readings for which there is early attestation and which are not found

in the Neutral text. The truly Western would be that found in the Codex Bezae and the African Old Latin, which would appear to be the result of very free handling by an editor; while besides this there would be a quantity of other early non-Neutral readings, which are not more Western than Syrian or Egyptian. The Chester Beatty papyrus gives no support to the extremer Western variations, but it suggests that many early non-Neutral readings are worthy of consideration on their merits; and those which found their way into the text used by so great a scholar as Origen are certainly not lightly to be dismissed. The new discovery has not lightened the task of scholars, but it has given them fresh material to work on.

St. Paul's Epistles.

The third part of the present publication contains portions of two manuscripts; ten leaves (out of an original hundred, approximately) of a copy of the Pauline Epistles, and ten leaves (out of about thirty-two) of a copy of the Apocalypse. Calculation based upon the remains of a page-numeration seems to make it certain that the Pauline collection included Hebrews (placed, as in the earlier Coptic version, somewhere between Romans and Philippians), but not the Pastorals. The papyrus appears to be of the third century, and probably of the first half of it. Unfortunately the leaves in the Chester Beatty collection do not include the later chapters of Romans, so that no light is thrown on the position of the verses xvi 25-27, which some manuscripts place at the end of Chapter XIV. Textually, the variants in the portion of the Epistles here preserved are not of great importance, and it suffices to say that the papyrus agrees most often with the Vaticanus, and next with the Alexandrinus and Sinaiticus. In Revelation, where again the textual variations mostly relate to single words or the order of words, the Chester Beatty papyrus (which appears to belong to the latter part of the third century, and thus is our earliest extant witness) agrees oftener with the early uncials than with the later uncials and the minuscules, but does not particularly favour any one of them, and is often independent of all.

For the Old Testament portion of the collection scholars must still exercise a little patience; but its preparation is far advanced.

A party of British gas engineers has just returned from a tour in the United States. The photographs of the Niagara power system on page 347 are reproduced from our contemporary *The Gas World*, of which the editor was a member of the party.

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R. S. Conway: A Memoir.

BY the death of Professor Conway on September 28th, DISCOVERY lost its founder and the main promoter of its activities. In 1919, when the country was just emerging from the war, and when its normal intellectual life needed a stimulus, Conway conceived the idea of a periodical which, while preserving the highest standards of scholarship, might present the latest results of research in all departments of knowledge on the authority of the foremost experts in their respective subjects, yet in a manner intelligible to those who were not experts, but who desired to keep themselves abreast of modern science and learning. That was the inspiration which gave birth to DISCOVERY, and that the ideal which it has always sought to follow.

It was part of a movement, in which Conway took a part with others, to put an end to the quarrel between science and the humanities, and to unite their supporters in the common cause of civilization; but in the creation of this magazine he was the prime mover. It was he who collected the first band of its supporters, formed its board of Trustees, selected its first Committee and found a publisher and editor.

In all the difficult years of its beginning he was the main driving force. Throughout its existence he has been its guide and the adviser of its successive editors. Through the breadth of his intellectual sympathies he was able to hold the balance even between science and the humanities, and through the height of his own ideals he was able to keep its standards high. Whatever success has been achieved in winning the respect and confidence of the intelligent public, though many have contributed to that success, all of them would agree that the main credit should go to Conway.

Robert Seymour Conway was born in 1864, and educated at the City of London School under Dr. E. Abbot, whence he passed as a scholar to Caius College, Cambridge, of which he was subsequently Fellow and eventually Honorary Fellow. From 1893

to 1903 he was Professor of Latin at Cardiff University College, and from 1903 to 1929 he held the same post at Manchester University. In these two places his main life-work was done. Always strenuous in everything that he undertook, he was a stimulating teacher and an active force in University affairs. But he was much more than a teacher. Amidst his

University work, he made himself one of the foremost Latin scholars in the country, and a vigorous advocate of classical education. He was for many years one of the most active members of the Council of the Classical Association, of which he was President in 1927. He originated the Classical Journals Board, which directs the periodicals managed by the Association. In every department of classical education, and in every movement to promote the interests of classical literature, he was always a stirring force and an untiring combatant.

In the department of learning, he made his own the province of the early dialects of Italy. In 1897 he published a work on *The Italic Dialects*,

and just before his death he had completed, in collaboration with Professor J. Whatmough and Mrs. S. E. Johnson, a monumental work on *Prae-Italic Dialects* in three volumes, in which all the extant materials for the study of this obscure and difficult subject are definitely collected and examined. But his especial devotion was to two of the great Latin writers, Livy and Virgil. Livy he edited, in collaboration with his friend C. F. Walters (and after his death with Professor S. K. Johnson) for the Oxford series of classical texts, a laborious task to which he devoted infinite time and trouble. On Virgil, who was nearest of all to his heart, he wrote a number of articles and lectures, full of enthusiasm, of original research, and fertile suggestion; and in the last years of his life he was engaged on an edition of the poet's works, to replace the standard work of Conington in all the light of the most recent research.

(Concluded on page 342.)



The late Professor R. S. Conway.

Science and Religion—I.

What are the Scientist's Moral Obligations?

By the Rt. Rev. H. Hensley Henson, D.D.

Bishop of Durham.

*"A new note of anxiety is audible in the utterance of the masters of science. Even the layman is perturbed when he hears successive Presidents of the British Association emphasizing the perils into which rapid progress is bringing civilized society. Like a mediæval magician the man of science seems to be raising demons which he cannot control."**

EVERYONE will agree that the scientific mind must be utterly disinterested. It must admit no kind of preference or prejudice. Its concern is with truth alone, and it pays no heed to the disturbance of reigning conventions which the discovery of truth may occasion, or with the practical advantages which the possession of truth may secure. The genuine votary of Science pursues truth for truth's sake. His curiosity is exigent and insatiable. He recognizes no degrees of importance. For him knowledge brings its supreme and satisfying recompense. Like Browning's Grammarian, he says:—

"Let me know all! Prate not of most or least,
Painful or easy!"

This disinterested passion for Truth did unquestionably bring its possessors into sharp antagonism with ancient and powerful vested interests in the spheres of Religion and Science.

The conflict between Religion and Science, which raged from the close of the Middle Ages to our own time, was, indeed, largely based on the mistaken identification of Religion with traditional theology. It has bequeathed to our time a copious literature, polemical and apologetic, which now lies on the shelves of our libraries unread and forgotten, save by the curious student. Its worst effect has been an unanalysed prejudice which darkens and confuses thought in both camps. Religious men have been disposed to cast back longing eyes on a receding past wherein Faith reigned without challenge, and to give but a grudging and reluctant recognition to the victories of Science. Bishop Blougram gave expression to a mental attitude which is even now far from uncommon among religious men:—

"You'll say, once all believed, man, woman, child,
In that dear middle-age these noodles praise.
How you'd exult if I could put you back
Six hundred years, blot out cosmogony,
Geology, ethnology, what not
(Greek endings, each the little passing-bell
That signifies some faith's about to die),
And set you square with Genesis again."

In effect, recent developments of Science have tended

to transfer the age-long conflict from the field of theology to that of morality. The practical problem, which I am inviting you to consider here, is concerned with the measure of authority which the man of science can by his own theory concede to ethical considerations. What precisely is meant by ethical impartiality?

So long as Science concerned itself with observing closely and registering exactly the facts of the physical universe, and so long as its conclusions were rightly drawn from its premises, it might and did come into conflict with the traditional beliefs of Christendom, but it did not necessarily affect the obligations and sanctions of morality. Theology was slow to learn and reluctant to yield, but in the end it has found no insuperable difficulty in accommodating itself to the teachings of astronomy, geology, even (though this is more difficult) of biology. But when Science proceeds to apply its experimental method to the body and mind of man, it soon passes beyond the sphere of theology to that of ethics, and begins to bear on men's conceptions of themselves and their obligations. The Moral Law itself, which is the grand cementing principle of ordered society, seems to be stricken with instability, and its claims, ceasing to be ultimate and sovereign, sink into a dependence on the conclusions of Science. Human nature is otherwise interpreted, and human duty has but a contingent authority.

Ethical Restraints.

Is there an accepted casuistry of the laboratory which can emancipate the scientific student from the ethical restraints which everywhere else he would unreservedly accept? May the formidable weapon of experiment be used without regard to any other interest than that of knowledge for its own sake? May not the ethical indifference of Science become a cloak of wickedness? Readers of "Kenilworth" will remember the casuistic argument by which the villainous alchemist essayed to silence the protest of his more scrupulous accomplice:—

"'You are to distinguish, my son,' replied the alchemist, 'betwixt that which is necessarily evil in its progress and in its

*Fison Lecture.

end also, and that which, being evil, is, nevertheless, capable of working forth good. If, by the death of one person, the happy period shall be brought nearer to us, in which all that is good shall be attained—when the art of healing shall be lost and absorbed in the one universal medicine, when sages shall become monarchs of the earth, and death itself retreat before their frown—if this blessed consummation of all things can be hastened by the slight circumstance that a frail earthly body, which must needs partake corruption, shall be consigned to the grave a short space earlier than in the course of Nature, what is such a sacrifice to the advancement of that holy Millennium?

"' Millennium is the reign of the Saints,' said Foster, somewhat doubtfully.

"' Say it is the reign of the Sages, my son,' replied Alasco, ' or rather the reign of Wisdom itself.' "

In effect, is scientific method morally unconditioned? And if not, how are the moral conditions to be formulated?

" Almost all philosophies and developed religions," writes Mr. Julian Huxley, " are agreed that truth, beauty and goodness are the three human ultimates to be desired for their own sakes, to be desired above all else. At least, they are agreed in theory; in practice, difficulties crop up as to interpretation and practical methods."

Nevertheless, Mr. Huxley will make no concession to the exigencies of practice:—

" It is often asserted," he says, " that there are certain things too sacred for investigation. But when the zeal for pure knowledge fills a man's mind, he not only may, but he must pursue his quest irrespective of where it leads him, neglecting all other attributes of the things investigated except its capacity for being understood. The fact that he or others hold it sacred is, for the spirit of pure intellect, mere irrelevancy. Further, as a matter of experience, it is always found that the knowledge thus gained for its own sake leads to a possibility of deeper reverence than what could be accorded before the facts were properly understood."

Mr. Huxley is concerned rather with religion than with morality, but his language may be extended to the latter. So the question presses. May we assume that the " three human ultimates " which are " to be desired for their own sake, to be desired above all else," are so inherently congruous with one another that he who pursues one shall finally gain the others also. " We must not divorce the three values," says the Dean of St. Paul's, " or set one against another," and again: " We are all of us climbers up the hill of the Lord which is ascended by these three paths which meet at the top. We shall probably find one of the three easier than the others."

I am not now concerned with the ultimate harmony of values, but with the practical inferences from our

faith therein. The Dean's metaphor of the three paths suggests the isolation of the climbers. But it is precisely that isolation which is in question. Granting that the " old quarrel between art and morality " is largely based on a misunderstanding of one or the other or of both, can the artist rightly hold himself indifferent to moral considerations when he sets to work in his studio? Is " Art for Art's sake " a sound or satisfying proposition? But we are here concerned with scientific method. Some confusion of the issue arises, perhaps, from our practice of carrying over the language of morality into the sphere of science. Thus we speak of the " Martyrs " of Science, suggesting a parallel with the " Martyrs " of Faith. The scientific student who submits himself to dangerous and even fatal experiments in the pursuit of knowledge is, it is suggested, a " martyr " in the same sense as the believer who goes to the stake in testimony to the truth of his religion. But the parallel is misleading. The religious martyr has no choice. He says with Luther: " Hier stehe ich, ich kann nicht anders." He goes to the stake under the coercion of his conscience, because he could only do otherwise by forfeiting his self-respect, and coming under the censure of all true men. But the scientific student is not in such wise coerced to his " martyrdom." He has an option, and whatsoever course he shall decide upon, he remains scientifically honourable. Not even an enthusiast for Science would maintain that it requires its votaries to offer themselves for vivisection. " It is only the moral consciousness which always speaks in the imperative mood," says Dr. Inge.

Science and Ethics.

I submit that scientific method is ethically conditioned in three respects. First, there are the moral obligations which attach to the scientific student by virtue of his manhood, and which cannot be cancelled by any scientific interest. Next there are the restrictions on the methods of research which are imposed by the claims of those whom they affect. Thirdly, there are limitations on scientific research imposed by the quality of the results which they are designed to secure. With respect to the first, we need say little. Scientific research demands the scientific temper. It must be carried on with single-minded loyalty to truth, with high indifference to personal interest, with frank self-surrender to toil and suffering in the quest.

The man of science may not pretend to a larger knowledge than he really possesses, nor impose on the credulous receptivity of the non-scientific multitude, nor bend his scientific authority to unworthy uses. All this is his plain duty because he is a man, and that

duty holds him as well in his scientific researches as in his other activities. He must accept for himself the high profession of that very eminent moralist, Mr. Gladstone :—

"I care not to ask if there be dregs or tatters of human life, such as can escape from the description and boundary of morals. I submit that Duty is a power which rises with us in the morning, and goes to rest with us at night. It is co-extensive with the action of our intelligence. It is the shadow which cleaves to us go where we will, and which only leaves us when we leave the light of life." (V. "The Vatican Decrees," p. 37.)

The "Watchword of Medicine."

This subordination of science to ethics was nobly confessed in the ancient world. The famous Oath of Hippocrates depicts the physician's professional activity as governed throughout by moral obligations. "Respected equally," observes Mr. Singer, "throughout the ages by Arab, Jew, and Christian, the oath remains the watchword of the profession of medicine." Nor is its relevance limited to medical science. Every other branch of science would accept the principle which it so nobly expresses.

So far there is no question. We take for granted that Science cannot release its votaries from the ethical conditions which control the rest of men, apart from which mutual confidence would become impossible, and self-respect would be deprived of intelligible meaning. When, however, we pass from the man of science to his methods of research, we enter the debatable land of casuistry. Science, like Religion, may here claim too much. In many respects, it is not superfluous to remember, Science holds in the modern world a position of authority analogous to that held by Religion in the mediaeval. Just as, in the Middle Ages, the background of human thought was religious, so now it is scientific. Science has largely replaced Religion in popular interest. If proof of the change were needed, it might be found in the altered direction of private benefactions, and the marked difference in popular taste. The gifts of the benevolent are now mostly given to hospitals and universities, rarely to churches. Sermons are now little read; the books of our leading men of science are eagerly purchased.

In succeeding to the power, will Science succeed also to the temptations of Religion? There is surely no more painful history than that of Christian casuistry, none more humiliating and more perplexing, and at the same time more suggestive. It is filled with paradoxes of almost inconceivable grossness. St. Paul's vigorous repudiation of the casuistic doctrine,

"Let us do evil that good may come," has not determined the practice of ecclesiastics or the theories of moralists. The practical question has rather been, "In what circumstances, and within what limits, may we do evil that good may come?" Is there a Jesuitry of Science as well as of Religion? Might a critic of Science find as ample material for a satire in the 20th century as the Jesuits provided for Blaise Pascal in the 17th? That no faith should be kept with heretics, that fictions and forgeries are permissible for the protection and advancement of orthodoxy, that the infliction of torture and even of death are lawful in the interest of the Church—these, and many other casuistic doctrines, have commanded the acceptance of Christian men and justified the worst actions which history records.

Is any analogous development likely in the case of Science? Does Morality condition scientific method? or does the alleged interest of Science over-ride moral considerations? This is the issue which properly underlies the obstinate controversy respecting that scientific method which is popularly, but inaccurately, called "Vivisection." It is noteworthy that those who, like myself, defend the use of that method are at one with its opponents in holding that it must be justified on moral grounds. The Royal Commission on Vivisection reported :—"After full consideration we are led to the conclusion that experiments upon animals, adequately safeguarded by law faithfully administered, are morally justifiable, and should not be prohibited by legislation."

Is Vivisection Justified?

The moral justification is based on the circumstance that the experiments are "adequately safeguarded by law faithfully administered." It is implied that, apart from such adequate safeguarding, vivisection would be morally unjustifiable. What, then, is the test of adequacy? What is the condition of moral validity which the law must be competent to secure? Is it the interest of knowledge? Is it the degree of the animal's suffering? Can it, then, be maintained that, while it is "morally justifiable" to inflict a little pain in order to gain knowledge, it is not "morally justifiable" to inflict much? The late Lord Cromer would seem to have taken this view. In his "Introduction" to Mr. Stephen Paget's well-known book, "For or Against Experiments on Animals," he declares himself to be completely satisfied that vivisection as carried out in England does not conflict with "the obvious dictates of humanity," and assures "lovers of animals" that they may cheerfully support vivisection. [To be continued.]

The Senses of Insects

By H. Eltringham, D.Sc., F.R.S.

It has been suggested that to insects the world is full of music we cannot hear, of colour we cannot see, and of sensations we cannot conceive. Describing the remarkable senses of insects, Dr. Eltringham explains how the butterfly can taste with its feet, and how the male moth can detect at great distance the scent of its female, imperceptible to us.

WHEN discussing the senses of animals other than ourselves it is desirable, if not always easy, to avoid purely anthropomorphic comparisons. Even in other vertebrates, whose organization is often very similar to our own, the psychic response to sensory stimuli may be already far removed from human conception. How much further must it be in animals whose nervous equipment presents hardly anything in common with that of a human being?

An Insect's Sensations.

We are somewhat handicapped in being compelled to use terms which apply to our own powers, since we have no words to define sensations of which we have no experience. Fortunately, however, it is unnecessary entirely to avoid terms commonly applied to our own faculties. Insects, like other animals, exhibit sensory responses to external influences, and if their organs differ from ours, at least the influences are the same.

We are at liberty to assert that an insect can see without committing ourselves to any psychic hypothesis as to what it can perceive. We may conclude that it can taste or smell, to the extent that it responds to contact or distance stimuli, without implying that it has the mentally æsthetic appreciation of the gourmet. It may respond to aerial vibrations, and to that degree may be said to hear, without having any power of analysis or mental estimate of tone, pitch, or harmony. We may even assign to the insect some vague elementary consciousness. The controlling factor in its life is the urge to reproduce its kind. Far behind this, since many adult insects do not feed at all, is the attraction of nourishment. No one who has observed insects can overlook the evidences of sexual excitement, nor do I find it easy to suppose that the butterflies on the Buddleia flowers, eagerly extracting nectar, fanning their wings in the sun, and waving their sensitive antennæ in all directions, are not experiencing something more than the mere mechanical adjustment of an unconscious appetite.

It would be impossible here to give a detailed account of the nervous equipment of an insect. The creature is divided into numerous segments which in some previous state of evolution were doubtless very

similar, both as to contents and external appendages. The primitive repetition of parts has become modified, and we now see a head, with complex mouth organs and antennæ, a thorax, formed from three segments more or less fused together, bearing the legs and, if any, the wings, and the remaining segments form the abdomen. The primitive system of repetition survives to some extent in the nervous arrangement, and each segment once had a mass of nervous material called a ganglion, which attended to the requirements of its own division. As the body became more differentiated some of these ganglia were fused together, and so in the head we find a mass representing several primitive ganglia, and forming what we can only call the brain. The three primitive ganglia of the thorax are often fused, but those of the abdomen remain fairly distinct. All are connected by a double nerve-cord lying along the ventral surface. Each ganglion governs the motor and sensory functions of its own segment, but the brain exercises a co-ordinating control.

Turning to the actual senses, the only insect sense-organs which are always easily identified and definitely located are the eyes, and their importance is evidenced by the comparatively enormous optic lobes of the brain. The vertebrate eye is a fairly simple organ, provided with a single lens, which produces, on the sensitive retinal layer behind it, an inverted image of the field of view. Insect eyes are of several forms and may be provided with a single lens or with many. The simple eye or ocellus has one lens and a nervous layer beneath it. It provides an inverted image, as in the vertebrate eye, but the nervous equipment is quite inadequate to record any considerable detail of the image so formed. This is due, less to the defects of the retinal apparatus than to the small size of the whole organ.

Powers of Vision.

The factor of size has been overlooked by almost every writer on insect vision. Professor Haldane has called attention to this very important consideration. The separate nervous elements in the human retina have a diameter of little more than the length of an average light-wave. For two objects to be distinguishable their images must fall on separate nerve-elements

If the elements were fewer but larger we should see less distinctly, since, were they twice as broad, two objects would have to be twice as far apart before we could distinguish them. If, however, their size were diminished and their number increased, we should see no better, since it is impossible to form a definite image smaller than a wave-length of light. Thus in a mouse's eye the nerve-elements are very little smaller than ours, and therefore far fewer. It probably fails to see objects clearly beyond a distance of about six feet. Eyes much larger than our own would not enable us to see much better than we do already, and those of large animals such as the whale and elephant are not much larger than ours.

The simple eyes of insects cannot therefore be of much use except to distinguish light from darkness, and perhaps to afford a coarse image at very close range. There are characteristics of the immature stages of insects, but in many species are also found on the heads of the adult forms, in addition to the large compound eyes. The number varies. Most caterpillars have six on each side. Some adult insects have one on each side, whilst others have an additional ocellus centrally placed.

The compound or faceted eyes may be comparatively very large, and the example of the dragon-fly at once suggests itself. Microscopic examination of this eye shows that it has an outer layer of minute lenses, said in some species to number over 20,000. Beneath each is a conical body of a semi-fluid consistency, and underlying this is a bundle of nerves, usually six in number, clustered round a central supporting rod. Experiment shows that each lens forms beneath itself a small inverted image, not of the whole field of view, but only of that part immediately opposite to it. As an image it is useless, since the semi-fluid cone beneath the lens transmits it to the nerves merely as a dot of light of the average intensity of the image. If we examine an ordinary newspaper illustration with a lens, we see that it is formed from a great number of dots of varying size, small in the

high lights and large or even confluent in the shadows. If a picture can thus be formed from dots of differing size, it can be equally, if not more perfectly produced by dots of differing intensity. It would appear that the image formed in the dragon-fly's eye is of this nature. The nearer the object the greater will be the number of lenses engaged, thus providing a correspondingly better image. On the well-known principle of the incidence of light, the number of lenses employed will be inversely proportional to the square of the

distance, which means that if ninety facets are engaged at a distance of one inch, only ten, or one-ninth of the previous number, will function at a distance of three inches. Thus the insect must be very short-sighted, though the accompanying rapid variation of definition must give it a very efficient sense of distance. The dragon-fly can, however, see over quite a considerable area well enough to recognize unfamiliar and therefore suspicious intrusions into its surroundings. A vague suggestion of some enemy is enough without the unnecessary details of such enemy's form and features.

This form of eye, producing what may be termed the light-dot or "half-tone" image is by no means the only type of compound eye. That of a butterfly, for example, has a cone beneath each lens, which, being of a harder consistency, is really a secondary lens, and that of a peculiar kind. It not only reinverts the image formed by the outer lens, but transmits it unimpaired down the transparent rod supporting the nerves. The butterfly, therefore, obtains a total image, not of little light dots, but compounded of minute images of the different parts of the field of view, all fitting together to make a complete whole, like a set of child's picture blocks all arranged together in their proper order and position.

I have no space to describe other types of compound eye, how nocturnal and crepuscular insects can adjust the amount of light admitted to the retina and make the most of a feeble illumination, or how, in order to reflect the light from the depth of the eye, moths

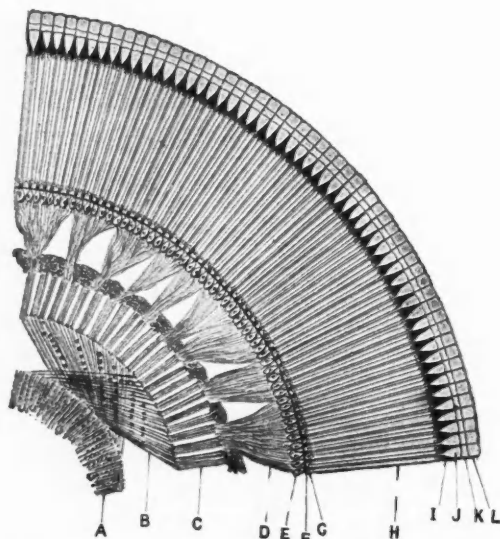


FIG. 1.—A section through part of the eye of a butterfly. The references are explained at the end of the article.

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have a mirror or tapetum, which though of quite different structure, performs the same function as the tapetum in the eyes of cats and other nocturnal creatures. Insects, within their limits of size, are well provided with organs of vision. A dragon-fly with some 120,000 nerve-endings may seem to be fully equipped. How far this mechanism falls short of human attainments can be appreciated when it is stated that the number of nerve-endings in the human retina is estimated as being of the order of 137,000,000.

We must pass on to the other senses. That insects are sensitive to touch is obvious to anyone who has given them the most superficial attention. In most species nearly the whole surface is capable of detecting tactile impressions. This sense is, moreover, discriminative, and whilst familiar contacts are disregarded, alien sensations usually cause immediate reaction. The seat of the sense is in certain hairs on the body, beneath each of which is a single nerve-cell having a thread-like extension connected with the base of the hair. The inner end of the nerve is joined by a fibre to the ganglion controlling its particular segment. Such an apparatus is termed a *sensilla*, and the insect has sensillæ of various forms scattered all over its body. All are not merely tactile.

Many have multiple nerve-cells with complicated nerve-endings, and herein lies the difficulty of locating the seats of special senses. Organs which we have good reason to suppose are olfactory may be found almost everywhere on the surface of the insect, though they usually occur in enormous numbers on the antennæ, and indeed it may safely be said that these appendages contain the principal olfactory centre;

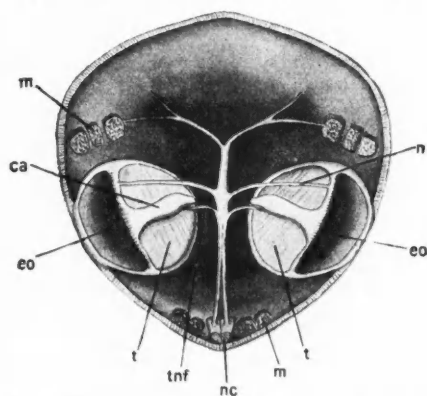


FIG. 2.—A diagrammatic view of the forward end of the abdomen of a common *Geometrid* moth, showing the "ears."

but they also contain other types of sensillæ, and we cannot experiment by inhibiting one type without damaging the others. Scent plays a very important

role in the economy of insects. They themselves produce scents of three different kinds: repulsive odours, produced by both sexes and serving as a

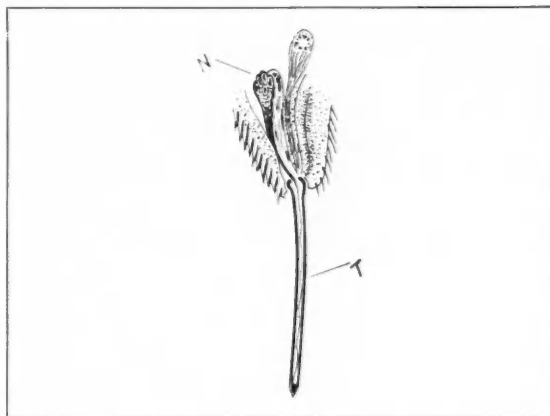


FIG. 3.—Section through one of the sense organs found on the legs of butterflies by which they seem to taste.

defence against enemies; directive scents, produced only by the female, and enabling the male to find her; and thirdly, if we are to judge by the extremely complex structures often associated with them, the most important of all, aphrodisiac perfumes, produced only by the males and having the effect of charming or exciting the females.

The power of scent in insects is something quite beyond our comprehension. Male moths will find their respective females from great distances. The directive scent is secreted by modified hypodermal cells in the extremity of the female abdomen. That it is some volatile chemical product may be proved by the fact that a box which has contained a female will be, for a short time, just as attractive as the female herself. Curiously enough these directive scents are all imperceptible to our senses. Many writers have for this reason denied that they can be scents at all, but the fact that they are beyond our range is no disproof of their existence. We cannot see infra-red or ultra-violet light but we know they exist. A normal person arguing against the existence of directive odours is in much the same position as a colour-blind subject discussing shades of scarlet.

In contrast with the imperceptibility of directive odours we find that many of the aphrodisiac perfumes are not merely perceptible but are usually, to our senses, agreeable. It is this importance of scent in the life of the insect which provides our best argument for the existence of an acute olfactory sense. Amputation of the antennæ in many cases inhibits

this sense, though it is not always confined to those organs, since some insects can find the substances in which they lay their eggs, such as carrion, after the antennæ have been removed.

As to the sense of taste, we should naturally expect gustatory organs to be associated with the mouth parts, but this is not exclusively so. A butterfly will sip a solution of sugar and immediately withdraw its proboscis on the addition of some distasteful substance. This is as we should expect, but if we assert that a butterfly can also taste with its *feet*, we realize that insect sense organs may differ widely, in both nature and position, from our own. The fact was discovered some time ago by Professor Minnich of Minnesota, and the present writer has recently described the organs involved. They consist of delicate tubular hairs, usually arising near the tarsal joints, and containing a fine nerve-thread which arises from a mass of nerve-cells in the hypoderm. If a butterfly be made to touch with its feet a piece of filter paper soaked with sugar solution, there is frequently an immediate response, indicated by the uncurling of the proboscis. Minnich showed that, for sugar, the insect's sensitivity was over 250 times that of the human tongue.

In the matter of hearing, organs to which we can with probability assign auditory functions are comparatively rare, the most elaborate being found in the legs of grass-hoppers, and described in most entomological text-books. The more complex of these seem adapted to appreciate a considerable range of pitch. Such organs are naturally more frequently found in insects which themselves make a noise, such as grass-hoppers and cicadas. It is less easy to account for their presence in species which, so far as we can perceive, do not themselves produce sounds. Organs of this kind occur in most moths, either in the thorax or the abdomen. They consist of a delicate membrane or tympanum to which are attached nerves having characteristic endings. As these nerve-endings are rarely, if ever, more than two in number, the organs must have a very restricted efficiency.

Senses We Cannot Perceive.

It has frequently been suggested that insects may have senses responding to stimuli which we cannot perceive. If so it seems likely that such specialization applies, not so much to the nature of the stimuli as to their range. Some species can see ultra-violet light which to us is invisible. Undoubtedly they react to scents we cannot detect, and they may well hear sounds beyond our auditory powers. To this extent

the late Lord Avebury's words may still be true: that to them the world "may be full of music that we cannot hear, of colour which we cannot see, and of sensations which we cannot conceive."

The following references refer to the illustrations:—

Fig. 1.—[Section through part of the eye of a butterfly.] [A] The Epipticon, part of the optic ganglion of the brain. [B] The External Chiasma, an area of the brain in which the nerve-fibres are crossed. [C] The Periopicon, the outermost part of the optic ganglion. [D] Nerve-fibres from the eye to the brain. [E] Layer of large cells whose function is at present unknown. [F] Basal membrane. [G] Layer of "Tracheal Distributors," from which arise delicate air-tubes not shown in the drawing. [H] The bundles of nerves forming the sensitive part of the eye. [I] The Pigment-sleeves which adjust the amount and direction of the light entering the eye. [J] The Cones, or secondary lenses. [K] Layer of transparent substance separating the lenses. [L] The outer lenses, of which there may be 5,000 or more in each eye.

Fig. 2.—[Semi-diagrammatic view of the forward end of the abdomen of a common Geometrid moth, after removal of the thorax and the overlying membranes, to show the Tympanal organs, or "ears."] *eo*, the external orifice leading into a hemispherical chamber, in shape rather like a kettledrum, of which the membrane or tympanum is shown at *t*. A stiffened arch, *ca*, lies over it, and from the under-surface of this depends a nerve attached to the tympanum. *nc*, the central nerve-cord. *tnf*, the branch supplying the tympanal nerve. *m*, longitudinal muscles of the body, cut across. *n*, nerve-branch to the tympanal support through which a degree of tension in the tympanum is probably controlled.

Fig. 3.—[Section through one of the sense-organs found on the legs of butterflies and other insects, and by means of which they seem able to taste.] *T* is a delicate tube, [in the Red Admiral butterfly about 1/4000 in. in diameter] containing a nerve-thread which arises from a mass of nerve-cells *N*. These are connected with the main nerve-cord of the leg. There are other cells connected with the organ but they are not of a nervous character.

R. S. Conway: A Memoir.

(Concluded from page 335.)

He would have loved above everything to be regarded as the accepted interpreter of the great master of Latin poetry.

His was a full and strenuous life, which has been cut off only a few years after his retirement from University work which gave him more freedom for his own studies. A special tribute to him is due from the readers of DISCOVERY; and no tribute would gratify him more than an assurance that the journal which he founded, and which he served with such devotion, was firmly established in the esteem of all lovers of science and the humanities, and would continue, after his death, to conform to the high ideals with which he started it on its course.

F. G. KENYON.

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Watching Birds in the North Atlantic

By A. R. Tripp.

The author of this article is a wireless operator regularly engaged on the North Atlantic steamship routes. He has therefore had exceptional opportunities for studying marine bird life. He notes particularly the occurrence of land birds at various distances from the coast, of which the meadow pipit five hundred miles from shore is a striking instance.

A SEAFARER'S leisure hours, compared with those of the landsman, are monotonous and devoid of vitality. There is no escape from the environment of his work and at the end of the day he has no family interests. If he can, in some way, make a servant of his exile, he will have done much to reduce the tedium of the long periods away from home.

Marine bird life is, of course, admirably available to the sailor for prolonged and systematic observation; and while the thrill of exploration can never be absent from any branch of science, it is keener here in view of the comparatively small amount of consistent observation which has been accomplished. It may be well, however, to point out that the advantages to the bird-watcher resulting from a professional life mostly spent at sea are to some extent offset by his inability to keep a continuous look-out; certain hours of each day having to be devoted to nautical duties; and owing to the seasonal shifting of the steamship tracks, which vary in a north and south direction according to the ice conditions in the western Atlantic, it is only possible to cover a specific ocean area at any one season of the year. In the whole cycle of seasons, however, the area embraced is considerable, as is shown on the accompanying chart. Many years of patient work and the co-operation of different observers is necessary in order to form reliable conclusions.

No detailed descriptions of the plumage and appearance of birds has been given, because it was chiefly in the hope that it would appeal to those actively interested in bird life that these notes were written. Those who have not more than a popular interest in the subject will not begrudge the trouble necessary to look up the details in an encyclopædia, or in any small descriptive handbook of British birds.

Land Birds at Sea.

From the point of view of the bird-watcher, one of the most interesting events during a voyage is the occurrence of land birds at various distances from the coast. Naturally this happens more frequently during the seasons of migration; in the autumn especially, in my experience, a vessel in our latitudes when near the European or American continents will often become the temporary resting-place of a number of different

species. The following cases are taken at random from my notes.

On September 27th, 1931, during a westbound voyage, when our ship was 60 miles south of Ireland and 110 miles west of Land's End, the following birds were observed around the decks and rigging: One robin, one wren, one wheatear, two spotted flycatchers, six willow-warblers and one kestrel hawk. The robin appeared to be the lighter-hued continental type, but of this I am not certain. The presence of the wren, normally a non-migrant, is hard to explain. It may have been blown to sea by strong winds or may have come aboard when the vessel was nearer to the shore. The former seems the more likely explanation when one considers the cautious nature of these birds. The kestrel flew off in an easterly direction after a brief rest among the rigging, but during the evening two more appeared and settled for the night on the foremast stays, near to the navigating light. By morning they and all the other stragglers had disappeared.

A Wheatear on Board.

Three days later, at a distance of 750 miles west of Ireland, I saw a wheatear flying about the ship and calling cheerfully in spite of being much buffeted by a strong north-westerly wind. It seems fairly certain that this was the original wheatear which had remained aboard in hiding and escaped further observation until this time; it is unlikely, otherwise, that at such a distance from land it would have shown so little sign of exhaustion. It was not possible to keep constant watch on it, and a few hours later it had disappeared and was not seen for the rest of the voyage.

Another case occurred on March 14th, 1932, when a meadow pipit, to my great surprise, came aboard at a distance of about 500 miles west-south-west of Ireland. This time there was some indication of tiredness and the bird spent most of its time with us on open deck spaces, crouching and occasionally walking in the creeping, mouse-like manner characteristic of these birds. It kept up its call-note incessantly while in flight. Such food as we could offer, and water, did not attract it. Migrating birds are credited with going great lengths of time without

food, and indeed very few land birds, in my experience, have accepted tit-bits while aboard ship during their nautical expeditions. Exceptions to this are the stray sparrows and pigeons which come aboard at all seasons of the year when the ship is near the coast. As in the case of the wheatear, it was unfortunately not possible for me to keep the pipit under continuous observation, and I saw no more of it for the rest of the trip. Presumably it had resumed its hazardous journey.

During May, 1933, while travelling eastward past the south coast of Newfoundland, three small birds like the common hedge-sparrow, and of about the same size, were observed aboard the ship. One feature distinctly unlike the sparrow, however, was a very pale yellow, almost white, streak running longitudinally on the top of the head. Perhaps they were some Canadian species, and I should be interested to know their identity. They remained on board during the entire eastbound journey and disappeared when we reached the English coast. The weather was calm and warm during the trip and the birds had an ample supply of food, obtained from the leavings after the teas and occasional other meals which were daily served on deck to passengers. Fresh water is almost always available in crannies in the ship's structure, in the folds of canvas life-boat covers, and so on. Perhaps we shall soon hear reports of a new species in the British Isles, as a result of these stowaways!

Racing and homing pigeons are often captured while the ship is near the coast and recently, on July 2nd, 1933, when we were in the western English Channel, four were caught and placed in cages pending our arrival in England. Three of them belonged to the National Union of Racing Pigeons and one was of Belgian origin.

The Snowy Owl.

An unusual and beautiful bird sought refuge on our ship on October 19th, 1932, in a position approximately 800 miles south-east of Greenland (the nearest land). It was a snowy owl. These birds are natives of the Arctic regions but have sometimes been seen in the north of Scotland. They are pure white, flecked with grey and are very thickly clothed, their beaks being almost obscured. Only their toes show through the dense, rather hairy under-covering which protects the bird from the Arctic cold. Their eyes are large and of a golden-yellow colour and the whole appearance of the bird, when standing in its normal upright position, is singularly suggestive of a sitting cat. Unlike most of the owls, they hunt by day. This specimen alighted on the roof of one of the "cabs"

at the extremities of the ship's navigating bridge and was captured by a sailor, using much stealth and a blanket. On the ship's return to England the bird was given to the London Zoological Gardens, where it may now be seen.

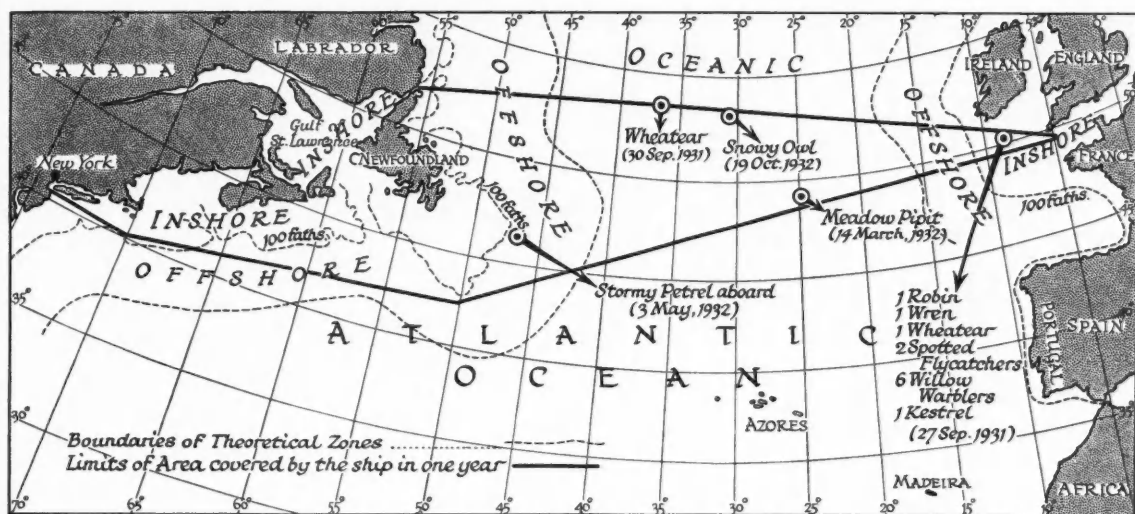
A Curious Visitor.

A curious incident took place late one night in May, 1932, when the ship was in dense fog in a position about 250 miles east of Cape Race (the south-eastern extremity of Newfoundland). We were in the iceberg region and consequently the ship had been stopped to await clearer weather. A friend, who was a passenger on that voyage, was walking on deck when a stormy petrel appeared suddenly out of the fog and flew against him with a considerable impact. The collision must have stunned it somewhat, for my friend had no difficulty in capturing it while it clung to his coat. He brought it to me under the impression that it was hurt, but petrels when on land can only shuffle along clumsily on their breasts, and it was impossible to tell from its floundering whether it was injured or not. All offers of uncooked fish placed in a large bowl of salt water—an effort to emulate as nearly as possible its natural feeding conditions—were refused. For about six hours it remained aboard, at first seeking the darkest corners; but later, from a point of vantage on the top deck, it flew strongly away to sea again.

A noteworthy point is that at no time was any oil ejected by the bird. Mother Cary's Chickens are reputed to have the power of squirting oil from the beak when they are terrified and I was eagerly awaiting a demonstration of this ability. Nothing availed, however, and I only hope that my not too cruel efforts at terrification did not permanently impair the bird's nervous system. It may have been that the first shock of collision in some way put out of action the apparatus used for this purpose, but, in any case, I was struck by the fact that the bird did not seem to be in the least excited or alarmed, from the time I saw it until it flew away. As it was the early breeding season, the flight of the bird into the brightly lighted but motionless ship may perhaps be accounted for by its impression that we were the shore, towards which its instincts would now be directing it. This petrel and the fulmar petrel (a related bird but about three times larger) are especially rich in natural oil, and this fact is made use of by the inhabitants of some of our lonely northern islands as a means of illumination. A wick is passed right through the body; the bird is then suspended and the end of the wick which projects from the beak is lighted.



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A chart illustrating the distribution of sea birds, showing the well-defined "natural zones."

Before passing to questions of the distribution of sea-birds, it is necessary to have an idea of certain constant and fairly well-defined "natural" zones. These were mentioned by Mr. Wynne-Edwards in *Discovery* for November, 1930, and he has named them the "inshore," "offshore" and "oceanic" zones. The three principal families of sea-birds which chiefly frequent them are respectively the *Laridae* (gulls), *Alcidae* (auks) and *Procellariidae* (petrels and shearwaters). The *Laridae* include the herring-gull, kittiwake, common gull, black-headed gull and the lesser and greater black-backed gulls. The great black-backed gulls, however, tend towards the "offshore" zone and the kittiwake, as we shall see shortly, is exceptional among the gulls in that he remains on the high seas all the year except during the breeding season, and must thus be assigned to the "oceanic" zone. It is a curious point that the "common" gull is not common. The herring-gull and black-headed gull are actually the commonest types. The accompanying chart, on the gnomonic projection, shows the approximate theoretical limits of the zones.

The *Alcidae* include the auks, razorbills, guillemots and puffins. The great auk, now extinct, was last seen in 1844. The *Procellariidae* include the shearwaters (three species) and the petrels (two main species). The stormy petrel, of which there are three types, is a small dark bird, only about six and a half inches in length, and sailors believe that its appearance at sea is associated with the approach of bad weather. This superstition has been explained by the fact that

it delights in gloomy surroundings and is therefore supposed only to disport itself during dull and overcast weather conditions. But I have frequently observed large numbers following the ship in the sunniest and most perfect weather. It is true, however, that when the bird is on shore, it usually remains in its nest-hole all day and only ventures forth after dark.

The gannets, or Solan Geese (one species) are lonely birds while on the ocean and are mainly confined to the "offshore" zone, remaining out at sea except while breeding. There remain the skuas (two main types) and the terns (five species), both closely related to the gulls. The skuas are also of solitary habits and seem, on occasion, to invade all the zones: I have often seen them in mid-Atlantic, at the western end of the English Channel, and well up the St. Lawrence River estuary.

There has been much discussion and correspondence as to whether kittiwakes cross the Atlantic. In my opinion there can be no doubt that they are constantly in the habit of doing so. The kittiwake is as strictly an oceanic bird as is the fulmar petrel, and statements that, although it strays farther from the coast than do herring-gulls, lesser and greater black-backed gulls, gannets, and so on, it is rarely seen in mid-Atlantic, are quite erroneous. During the depth of winter kittiwakes are the most numerous and consistently present species all the way across the north Atlantic, while the fulmars are mostly farther south. During the middle of summer the position is reversed and kittiwakes are fairly rare, while fulmars are relatively abundant. This is the most marked and wholesale

seasonal movement to be noticed on the north Atlantic in these latitudes and may be explained as follows.

In spring, both kittiwakes and fulmars work northwards to breed, but the former reach higher latitudes than the latter; thus, few kittiwakes are seen in the summer, whereas fulmars are numerous and become increasingly abundant as dispersal from the breeding centres proceeds. In autumn, again, both move southwards, the fulmars attaining lower latitudes than the kittiwakes and consequently the latter are abundant during the winter months—especially so because there is no breeding in progress. As the fulmars frequent our temperate latitudes only when they are breeding, they never at any time attain the abundance of the kittiwakes, though they are seen in sufficiently considerable numbers to indicate that breeding operations are not abruptly wholesale but are spread more or less evenly over the spring and early summer months.

Throughout the year great black-backed gulls and the great and sooty shearwaters are more numerous on the western side of the Atlantic than on the eastern side, and in this area also the birds of the "inshore" zone (such as herring-gulls and lesser black-backed gulls) follow an eastbound vessel on the tracks south of Newfoundland to greater distances from the land than is the case with a westbound ship leaving the European coast. This is no doubt due to the influence of the Grand Newfoundland Banks, which have the effect of extending the 100-fathom line eastwards to a longitude of 48 degrees west (see chart). This line wherever it occurs, forms a fairly accurate boundary between the offshore birds which, although remaining at sea for most of the year, do not wander to such great distances from the coast as do the "oceanic" types; and those of the "inshore" zone which come ashore frequently at all times of the year. The division of types is much more abrupt when approaching or leaving Belle Isle Strait (which forms the northern entrance to the Gulf of St. Lawrence and lies between the coasts of Labrador and northern Newfoundland). Here, the 100-fathom line—or edge of the "Continental shelf"—is quite close to the coast, and I have often seen abundant fulmars completely replaced by equally numerous herring-gulls within the space of two of three hours, and *vice versa*.

Considerations of Food.

It seems to be largely a matter of suitable food. The herring-gull is omnivorous and finds less difficulty and needs less exertion in relying for its supplies upon the pickings at low tide and in the vicinity of trawlers

but the true sea-bird is dependent upon its fishing successes.

There is a zone roughly between longitudes 20 W. and 25 W. (a mean distance of about 400 miles west of Ireland) where I have often noticed a complete absence of birds. This may be a fluctuating and seasonal zone rather than a permanent and stationary one, and in any case, requires more data to free it from the possibility of mere coincidence.

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BASIC ENGLISH.

To the Editor of DISCOVERY.

DEAR SIR,

Such of Mr. Butler's arguments as are worthy of the attention of your readers have been dealt with at length in the volume entitled *Debabelization*, to which reference was made in my article (*Discovery*, September, 1933). The others, I hope, he will discard before their irrelevance has detached from the Esperanto cause its few remaining British adherents. Esperanto is an interesting psychological experiment, even if it has no practical significance, and it would be a pity for it to fade away like Volapuk through the intransigence of its officials.

Your other correspondent, Mr. Beer, who asserts that the East has little interest in "pidgin Anglo-Saxon," seems to be unaware that any "cultured European" can understand more than fifty per cent. of the Basic vocabulary at sight. And since the standardized terminologies of international science on which Basic depends for scientific purposes are ninety-nine per cent. Greco-Latin, it is hard to see what is keeping his Occidental friends so busy—unless it be their feud with Esperanto, Ido, Novial, *et hoc genus omne*.

Yours faithfully,

The Orthological Institute,
Cambridge.

C. K. OGDEN.

DEAR SIR,

English is the language not only of America and Great Britain, with their 200,000,000 inhabitants, but of the whole world, whose second language it has already become: English is now the means of expression of every race and creed, of every colour and every period. Alone of all the tongues of mankind, English can do equal justice to the white man and the negro, to the Christian and the Buddhist, to the most advanced intellectual and the most backward bushman, to the scientist and the coolie. Alone it offers within its fold a double language, making it possible for the untaught labourer of a backward race to make himself understood with a total vocabulary of some 850 words by the aid of the simple and ingenious Basic technique. It is thus the easiest language to learn and yet the one which offers the greatest reward to the student; it contains within itself every transition from the lowest to the highest. It has evolved more in its simpler forms, and it is more potential of evolution in its newer forms, than any speech mankind has ever known.

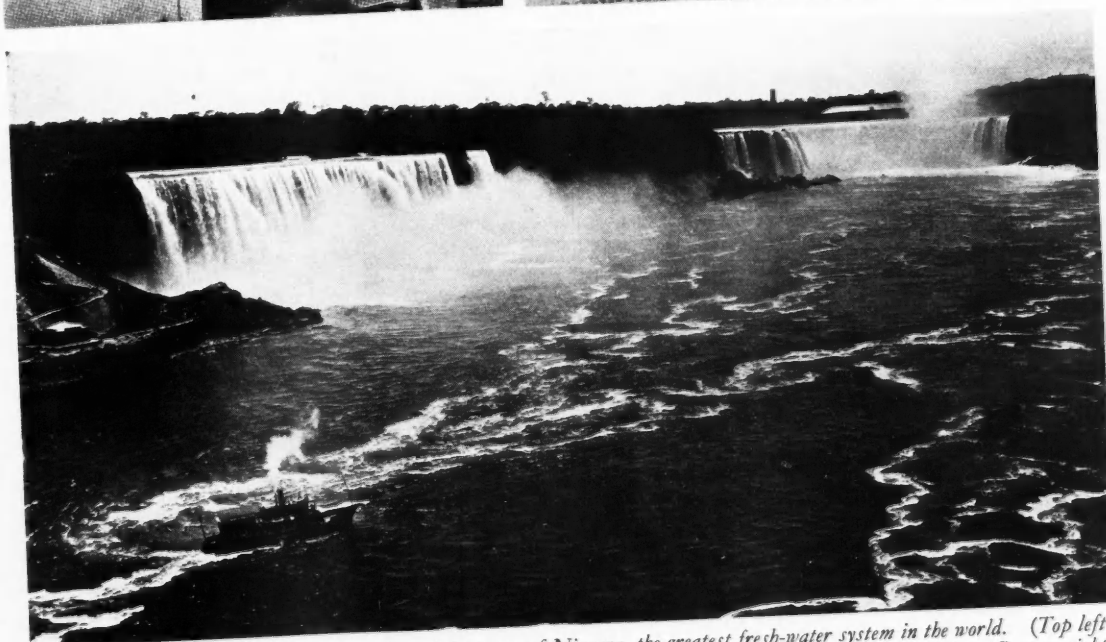
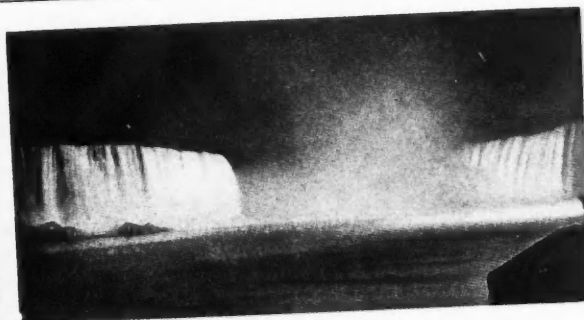
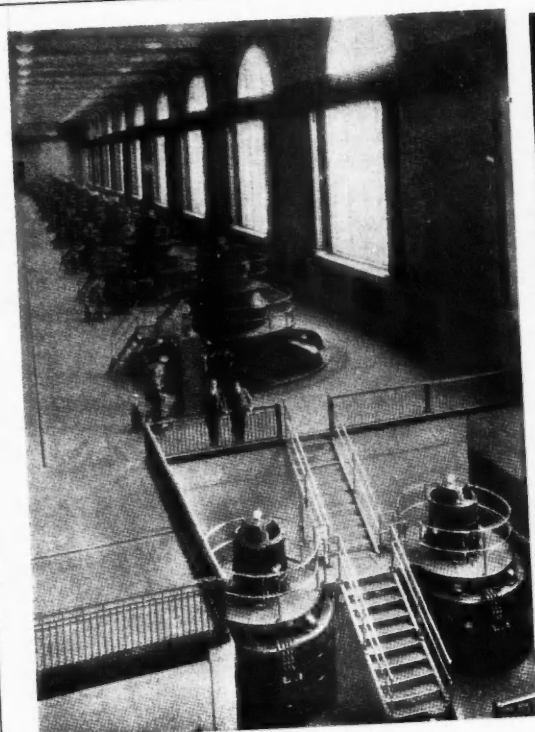
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"INTERLINGUIST."

Discovery—November, 1933



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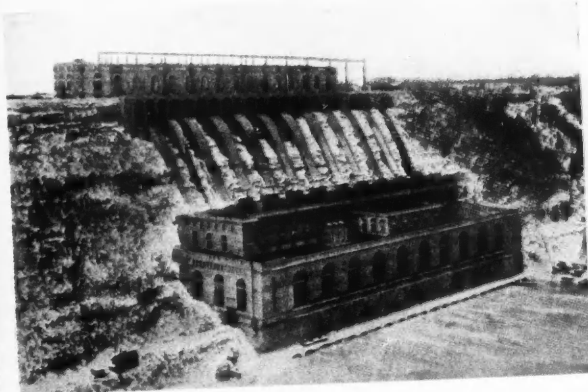
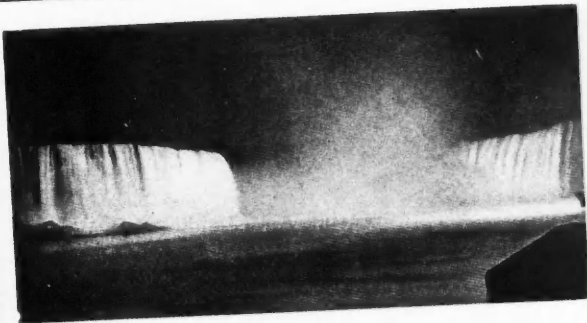
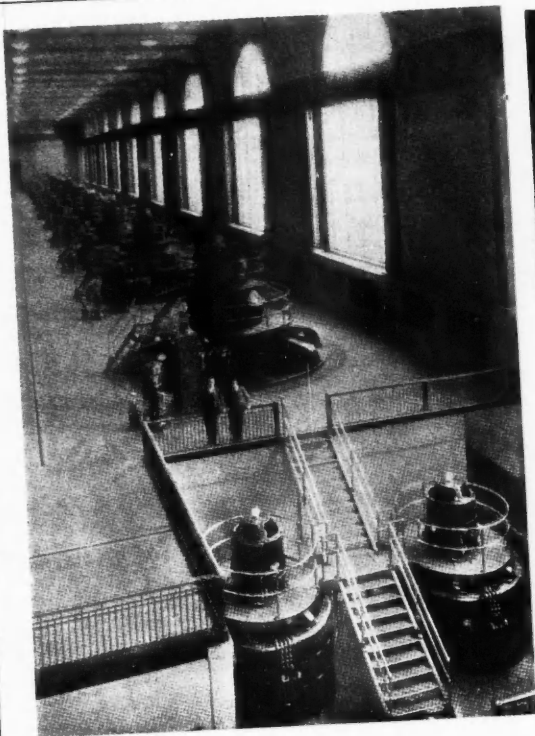
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On a Houseboat in Kashmir.

By J. Ethel Salisbury.

This account of a holiday on a houseboat in Kashmir concludes the prize-winning essays entered by readers for our travel competition. The Indian boatmen live a picturesque and leisurely life of their own, untouched by influences from the outside world; the native houseboats are shared by men and cattle alike.

IT had become very hot in a station in the United Provinces, so that a holiday was indicated. What could be more novel or more interesting than a houseboat tour in Kashmir? On the train journey up to Rawal Pindi we were feeling limp and jaded, and could take little interest in the scenery. But as we approached our destination the difference was so marked that we could not help noticing the dry earth, which seemed almost as if it were sculptured.

At Pindi, we stayed for a night to rest and arrange for a car to take us to Kashmir. The distance is two hundred miles and the road a difficult one. The driver must be an experienced man or the car and its occupants may well be hurled down the steep kud to the roaring river below. The roads are winding and tolls are numerous. Fast traffic only is permitted during the day, so that one constantly meets encampments of drivers and their families, with unyoked bullocks and carts.

We worked up to 8,000 feet to the hill station of Murree, from which a remarkable view is obtained. We then drove down to Kohala, at 2,000 feet, where a suspension bridge crosses the rushing river; here are the last rest house and toll before entering Kashmir. The scenery is magnificent—torrential rivers, dense forests, and towering mountains. Since timber is the chief industry of Kashmir it is not surprising to see thousands of tree trunks, sometimes singly, sometimes fastened together as rafts, floating down the river. The principal trees are chenar, deodars, birch, maple, firs and walnut, a large number of which are used in the construction of houseboats and dwellings.

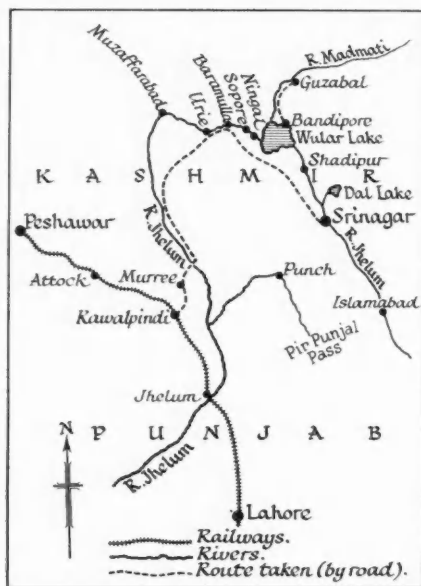
Our first night was spent at Domel in one of the Maharajah's rest houses. The next halt for rest and refreshment was made at Baramulla, which, like all

Kashmir towns, is extremely dirty, although it is one of the four largest in the country. Baramulla exports fruit, grain, homespuns, carpets and thick felts from Yarkandi. It is a busy commercial centre, and the eighty miles of river between Islamabad and Baramulla are alive with traffic.

Approaching the capital, Srinagar, are avenues of poplars and chenar trees. It is a charming town and possesses seven bridges which span the river Jhelum. The best known to Europeans is the Fourth Bridge, which forms the shopping centre. A magnificent view is obtained by climbing the hill known as Takht-i-Suliman, or the Throne of Solomon, on the peak of which is a Hindu temple. Almost everything may be bought for the journey at the local departmental store. We are greeted by many salaams from the biblical-looking owner and his sons. Then we are introduced to the boatman, Rahman, big, burly, and very dirty, but a cheerful rogue and well able to manage the boat, its ragged crew and ourselves, all to his own advantage. Any European provisions that we

may require we must buy here as there will be no chance of buying *en route*.

The intention is to pitch camp for trout fishing, so besides the camp equipment that Rahman has already purchased, we must buy *quiltas*, baskets in which our provisions are carried on the pack ponies. The store sells Kashmiri work such as silver (sold by weight), silk, embroideries, walnut carvings, and papier maché. We now take a taxi to the river. Here it is very busy. Rahman shouts for a *shikara*, or river taxi, plying for hire. It is gaily adorned with red embroidered curtains and cushions. We are soon brought alongside our new home, which is in the Dal Lake. This is a *doonga*, a small



Sketch map of the author's route.

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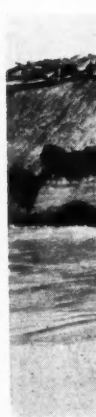
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houseboat, resembling Noah's Ark in shape but not in other ways.

The "cook boat" which followed us housed the servants, the crew, with Rahman, his wife and family. I could just see by craning my neck that holy of holies, the cook house, with its rows of bottles, including the famous *sass* (a sauce which the native cook is never without), condiments of various kinds and other vital ingredients for the preparation of the *khana* for the Sahib. Sometimes Rahman did the cooking; more often he was smoking his hookah while his deputy did the work.

Our chief object was to catch as much Indian salmon (*mahseer*) as possible, so Rahman arranged to pole us to suitable spots. The next halt was at Sopore. Near by, at Ningal, was plenty of fishing. The Sahib caught a *mahseer* weighing 27 lbs., and for that year it was quite a good size as they had not had large catches.

The river banks are interesting and the scene is always varied. The natives are to be seen washing either their clothes or themselves, cleaning pots, grinding corn in the old-fashioned way. Here is a small boat, paddled by a child who uses an oar shaped like a spoon. With her is an old lady. They are collecting water weeds which they will use for their beasts. Here again is a stout country boat; it contains a large family, the men lazily smoking hookahs, the women working. On the roof of the boat are herbs and vegetables drying. A cow as well as chickens are also inside! The natives have no idea of sanitation, so that often this lovely country is swept by terrible plagues.

Sopore is left in order to pitch camp at Guzabal for trout fishing, so the *doonga* remains tied up. We must cross Lake Wular, where terrific storms come up so



The author's houseboat on the Dal Lake.

suddenly that the light houseboat would be smashed to atoms, so we hire a country boat. Permission has been granted for trout fishing, though the rivers are strictly preserved. We start for Bandipore on the other side of the lake. Bandipore is in the midst of a rugged and mountainous grandeur. Few European boats were there, but there were scores of native boats, shared by men and beasts alike. The village is very dirty. It is interesting, however, to see many people from Baltistan and Ladakh. They come on pack ponies, and one sees many animals, still loaded, standing under the shade of trees. These hill men are strong, and wear rough woollen clothes and caps. The women are exceptionally handsome, with their long cloak-like garments.

From Bandipore we started for Guzabal, our ponies and coolies being ready. The ride was not a hard one and lay through magnificent scenery. At Guzabal camp was pitched, and this remains one of the most memorable recollections of our journey, for we were nearly caught in torrential floods.

After a few days at Srinagar, we moved to Islamabad, one of the four largest towns. The Hindu name is *Ananth Nag*, meaning the Place of Many Springs. This is an important centre for *gubbas* (carpets) made of bright pieces of material, embroidered covers, and *numdahs* (rugs). From Islamabad, we returned to Srinager, to conclude our delightful holiday. Once more in civilization we remained in the Dal Lake, an interesting and picturesque waterway. The excursions on the Dal Lake, and to the lovely gardens made by the Moghuls, such as the Shalimar Bagh and the Nisham Bagh, are memories which will never be forgotten. Indeed, anyone with the time to travel far afield cannot do better than take a houseboat in Kashmir, for there he will find more peace, and more novelty, than anywhere else.



The "cook-boat" runs aground on the sand.

New Problems in Plant Breeding.

By R. G. Stapledon, C.B.E.

Director of the Welsh Plant Breeding Station.

The Welsh Plant Breeding Station is among the chief centres of agricultural research in this country. Problems of the utmost importance to agriculturists are here being studied under the direction of Dr. Stapledon, who has just issued his first report. The following are extracts.

PESTS and plant diseases from the point of view of the destruction they cause are of three main types. There are those which undermine the general health and vigour of the plant, causing wholesale loss of crop or greatly reduced yield. There are those which attack certain definite parts of the plant and cause loss in particular directions; such are the pests and fungous diseases which interfere with seed formation or destroy the seed. The latter as regards herbage plants may be of little significance in pastures and meadows, but may be wholly or partially destructive to seed crops. Then there are those diseases which, although not necessarily serious in relation to ordinary crop production, are particularly liable to attack plants in pots or those grown under other artificial conditions in connexion with the actual breeding work. At the Welsh Plant Breeding Station it has been possible to conduct detailed researches into many of the diseases which have caused the greatest amount of trouble.

Clover Sickness.

In so far as herbage plants are concerned, there are not many diseases in this country that cause wholesale destruction to the plants in an ordinary mixed sward. Examples are the organisms (both fungus and eel worms) which cause "clover sickness." "Clover sickness" does not, however, occur to any extent in West Wales, and one consequence of this is that we have not been able to undertake breeding work with a view to producing strains of red clover immune to these diseases. "Scorch" due to the fungus *Kabatiella caulivora*, a disease which has come into prominence in recent years, causes considerable destruction in pure stands of red clover. It is probably the most serious disease affecting red clover seed production. It attains to its maximum virulence when the crop is in bloom, attacking both petioles and stems. The disease injures the stem to such an extent that the flower heads are inadequately nourished. The intensity of the disease varies from year to year, but in 1926 the exceptionally low yield of only 50 lb. per acre of Montgomery red clover seed at the station farm was due almost entirely to this cause. The fungus is responsible for considerable losses amongst the red clover plants employed for breeding work.

Clover leaf spot (*Pseudopeziza trifolii*) is decidedly prevalent in some years. It spreads very rapidly causing most of the lower leaves to shed, reducing functional activity of the plants, and thereby inhibiting seed development. This disease is, therefore, to be regarded as sometimes serious in relation to seed production.

All the grasses are very susceptible to attack by a number of rust fungi. In some years rust, particularly late in the season, shows itself in an unmistakable manner even on mixed swards. Rust is capable of running right through a seed production crop of a pure grass species; a large majority of the plants may be killed outright, and in any event the seed crop will be greatly reduced. In practice, however, the plant breeder by constant, long continued and informed selection from non-rusted plants and by the complete rejection of families highly susceptible to rust has little difficulty in producing strains quite sufficiently resistant to these diseases. The rusts on grasses afford an excellent example of plant breeding as one method of combating disease, and a detailed genetical study of the inheritance of rust resistance in timothy is being made with a view to breeding a completely resistant strain. The rusts, as well as being among the best known of plant diseases, are also particularly interesting. It is among the rust species that we have such striking examples of biological races, involving highly selective specialization, and rendering "immunity" only partial unless a particular strain of a particular grass is immune to all the races of a particular rust.

Studies of Grass.

The rusts then are to a large extent locally selective in their incidence. This has been admirably demonstrated in connexion with the collections made with grasses from many parts of the world. Plants of excellent characteristics and appearance have been grown from seed obtained from Norway, Sweden, Russia and Finland in the case of cocksfoot, meadow foxtail, sweet vernal grass and other species. In many instances, and this was particularly striking in respect of four lots of cocksfoot from Russia and two lots of sweet vernal grass from Finland, all the plants

were so badly rusted (yellow rust *Puccinia glumarum* in the former case and *Puccinia anthoxanthi* in the latter) that none of them survived into the second year after planting out. This occurred although the numerous selections from British plants were showing little or no rust and no single British plant of either species was killed. It follows from this (the plants were numbered strains received from experimental stations) that to breed a particular grass absolutely immune to all rusts in all parts of the world would be a considerable undertaking, and that ordinary methods of straightforward elimination of rusted plants can be guaranteed to have done nothing more than to have produced a strain reasonably immune to rust in the district where the selections have in fact been made.

Rust in Cereals.

In Wales the rusts are also serious diseases in the case of cereals. Some years crown rust (*Puccinia coronata* Corda) on oats amounted to a really serious menace. Careful notes taken over a number of years indicated that the potato oat, a variety very popular in parts of Wales, is particularly liable to the ravages of this disease. The co-operation of the plant breeder and the plant pathologist seemed to be indicated. Red rustproof, a variety of *Avena sterilis*, a type of oat not used in this country and with a rather undesirable grain character, was selected as the best resistant variety to use. Selections were made of plants absolutely resistant, and from among these a resistant parent was chosen for crossing with a highly susceptible potato parent.

A special technique was employed for the purpose of infecting the progeny as seedlings with spores of the rust fungus. Thus, the mode of inheritance of susceptibility and immunity was studied throughout a number of generations, and plants were finally selected having a high degree of immunity to rust. The aim, of course, was to breed an oat of the potato type definitely resistant to crown rust. The evidence is not yet complete, but there appears to be some doubt as to whether it will be possible to select a strain at once resistant and devoid of certain undesirable grain characters typical of the red rustproof parent. This illustrates the difficulties that are encountered in work of this sort, and only future study will show whether there is an absolute linkage between resistance and undesirable grain character such as would preclude all possibility of producing an oat of truly "potato" characteristics resistant to rust from a cross with an oat of the red rustproof type.

Bunt in wheat (*Tilletia tritici*) affords the most widely known example of a fungous disease affecting

seed production—grain yield in this case. Bunt is very plentiful in Wales, and our work with the Hen Gymro wheat served to emphasize the extent of the damage done by this disease. Bunt is also of interest because it affords an outstanding example of a seed-borne disease. Recent investigations have done much to assist the introduction and general utilization of dry treatments in this country. It was found that not only did copper carbonate, applied at the rate of 2 oz. per bushel of grain, give good control of the disease, but that it was also superior to formalin in its effect on growth and final yield.

The excellent yield from grain which had been dusted with fungicides was in fact so striking that critical experiments were arranged in order to discover the cause. From these experiments it was established that the bunt fungus influences the development of the wheat plant making it less winter-resistant and so retards growth in height, with the result that infected plants produce shorter straws (but rather more heads) than normal individuals. Copper carbonate, therefore, not only results in a cleaner crop but eliminates these defects in growth and gives a better yield.

To test the validity of the view that copper carbonate and other treatments "stimulate" growth, critical tests were made of their effect on bunt-free grain. The conclusion was reached that the stimulation hypothesis is without a sound basis, but it is certainly often the case that copper carbonate and other dusts applied to the grain before sowing have a beneficial effect over and above that due to bunt control. This effect is, we believe, fungicidal, and results from the fact that the dusts remain on the surface of the grain, thereby protecting the germ from fungi present in the seed coat or in the soil.

Various chemicals have a similar effect to copper carbonate, and in recent years organic mercury compounds have been widely recommended.

A Grassland Pest.

As a further example of a disease adversely affecting seed yield, we may instance an insect pest—the midge which attacks meadow foxtail and which renders seed production such a difficult matter in the case of this definitely valuable grass. By far the most troublesome species in all the districts in which we have had experience is *Contarinia merceri*. The larvæ of this species drop from the seed (which has been rendered abortive) before or at harvest time and ordinarily, therefore, do not contaminate the seed as distributed and offered for sale. The midge, however, occasions very serious reduction in seed yield.

The Ancient Roads of the Maya.

The discovery in Yucatan, Central America, of a stone road roller is evidence of the fact that this uninhabited jungle was once the home of a flourishing people who numbered among other accomplishments the building of paved roads. An expedition from the Carnegie Institution has lately investigated the region.

COBA, a Maya city of consequence during pre-Columbian days but now long abandoned, lies about sixty-five miles south-east of Chichen Itzá, the headquarters of the archaeological field staff of the Carnegie Institution of Washington. A study of Cobá and the surrounding region has revealed the fact that it is at the centre of a network of raised roads which run north, east, south, and west and connect various groups of ruins located about the chain of small, fresh-water lakes. One great road which runs westwards from Cobá had been thought to end at the ruins of Yaxuná, about twelve miles south-south-west of Chichen Itzá, but no one had ever traced its course from end to end.

The region is difficult to traverse. Low bush and jungle, the characteristic covering of the section towards the west, merging as it does with the tall rain-forest towards the east, effectively obscures all surface features. Again, the limestone formation which underlies the entire area is so porous that water is not to be had except in a few favoured localities, the Cobá district, with its chain of lakes, being the most notable. Moreover, the region round Cobá is without permanent population. A few chicleros, who engage in tapping the sapodilla trees during the rainy season and who occupy temporary camps, and occasional hunters in search of game, are the only people now to be found in a region which once sustained a numerous population. Because of these conditions and because of the difficulty of penetrating the jungle where no trail exists, this once magnificent highway, glimpsed only here and there at breaks in the forest growth, had never been followed through.

For many years, Dr. Sylvanus G. Morley, in charge

of the Carnegie Institution field staff, has hoped for an opportunity to determine the facts about this the greatest of all the causeways running out of Cobá. Finally, this year the time seemed propitious and he set about organizing and equipping an expedition. To head the expedition, he chose Alfonso Villa, a young school-master of the Yucatecan race. He was commissioned to select twelve Maya Indians to accompany him, to equip a pack-train with supplies and water-carrying receptacles, to enter the road at Yaxuná, and to follow it wherever it led, making a traverse survey as he went.

On February 27th Villa and his party entered the jungle at Yaxuná prepared to trace the road, to plot its curves, to measure its length, and to study the details of its construction. Three weeks later the party emerged from the forest at Cobá, 62½ miles distant, as shown by a steel tape which the party carried. By following the road throughout its entire distance Villa demonstrated conclusively the correctness of early conjectures that Yaxuná and Cobá were the termini of this great causeway.

It was while cutting his way through the thick bush, twenty-two miles out of Yaxuná, that Villa came upon a stone roller, which may fairly be called the first American road roller—lying on top of the causeway towards one side, in all probability just where it had been left by the builders centuries before.

Sun and wind and weather and the passing years have treated it badly for the shaft is broken in two. Segments of considerable size have flaked off, but enough remains to satisfy the observer that it had been quarried and given cylindrical shape for a purpose, the most plausible being that of use in road construction and road upkeep. It seems probable



An aerial view of the dense jungle in Yucatan which was once occupied by a flourishing civilization.

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that this stone cylinder was designed to be used in packing down into solid mass successive courses of material, particularly surfacing material, as these were added in the process of road construction. Presumably, gangs of labourers on the road, possibly slaves, possibly captives taken in combat, pushed such cylinders about

as the work proceeded and in so doing anticipated by many centuries the advent of the modern steam-roller.

At the Yaxuná end the road takes off from a small pyramid at the centre of a great number of mounds, originally structures of various types, which now, however, except for a single acropolis-like building, still standing but badly weathered, comprises all that is left of this once important city. For forty-three miles out of Yaxuná the road runs almost perfectly straight and in the remaining nineteen-and-a-half-miles, its original direction changes but four times, and only slightly at that. In width, the road is from thirty to thirty-four feet; in height to which it is built up above the surface level of the terrain, it varies from two to eight feet.

Villa reported having observed convincing evidence that the road once connected numerous settlements, some of them of considerable size. At intervals along the road he came upon small platforms from thirteen to sixteen feet in height, but badly disintegrated. The purpose of such structures is unknown, but he thinks they may have served as wayside shrines. Villa also found evidence that at various points walls had once been built squarely across the road, as if to close it, perhaps defensively, to hostile groups. Upon nearing the Cobá terminus another feature of particular interest is to be noted, that of six stones about two-and-a-half feet high, one-and-a-half feet wide, and one foot thick, inscribed on one face in each case with Maya hieroglyphs. These stones are scattered along the road surface at fairly equal intervals over a distance of seven miles.

When discovered a few years ago they were lying flat, but whether this was their original position or



The remains of a primitive road roller found on an ancient Maya road. It is a cylindrical section of limestone, thirteen feet long.

stones were placed for the purpose of recording the date when a section of the road was completed or dedicated. Others have suggested that they might have been set up to mark distances, after the manner of the milestones of many of our modern roads.

In construction of their roads, the ancient engineers began by digging down to the hard substratum, which is near the surface, and erecting retaining walls on either side to the height to which they desired to bring the road. These walls were built of large, roughly faced limestone set in mortar. Into the space between the walls a layer of heavy boulders, some of them two or three feet in length and weighing many hundreds of pounds, were carefully laid and the spaces between filled with smaller stones, fitted, and hammered into position. Other courses followed, each of successively smaller boulders and stones, quite as carefully placed, until the road had been brought to the proper height, whereupon a layer of rock broken into much finer pieces was added. After this was hammered or rolled into a hard, level surface, a final coating of mortar cement was applied.

The modern Indian name for the ancient stone roads of Yucatan is *sache* (plural, *sacheob*), which means literally "white road." The name is of remote origin; it is probable that it is the name the builders themselves used though this is not certain. However this may be, the name is peculiarly expressive, for the surfacing coat of mortar cement which was applied was made of lime mixed with finely sifted white earth called *sascab* which originally, under the tropical sun, must have given the roads a dazzling appearance, quite as dazzling, perhaps, as our modern roads.

Mr. Earl Morris of the Carnegie Institution, has

whether they stood upright is not known. The hieroglyphs are too badly eroded to be decipherable, but enough remains to show that the carving was well executed. Mr. J. Eric Thompson, formerly of the Carnegie Institution, who has made a special study of the monuments of the Cobá region, thinks it possible that these inscribed

studied the processes used by the Maya builders who worked with stone, and says that this *sascab*, or white earth, is a sort of breccia or conglomerate lying beneath the limestone cap-rock of the country, and that in ancient times it was mixed with slaked lime as masons to-day use sand. He adds that the miners burrowed for it wherever the digging was easiest and that the region around Chichen Itzá is full of caves where it was dug, one of them being twenty feet deep and large enough to shelter two hundred people.

The Building of Temples.

It was cement made in this way that was used to such good effect in temple construction, providing hard and durable coverings for the floors, and the fine-grained wall surfaces of glossy smoothness so suitable as backgrounds for the frescoes and murals with which the ancient artists adorned the walls. Mr. Morris states that in more leisurely days the masons took great pains in preparing the cement, stirring and remoistening it daily for many days and, when applied, tamping it with wooden mauls for hours on end until it became as poreless and as compact as stone. He also says that, when needed, the surface paste, as it was being tamped and finally trowelled, was remoistened with a solution made by soaking the bark of the *chilom* tree in water. Given this treatment, the cement is not only rendered practically impervious to water but, under the trowel of the mason, it takes on a magnificent polish.

Although evidence of the existence of *sacbeob* has been found at a few points in the Yucatan Peninsula, the Cobá region is unique in the extent and elaborate nature of its system of causeways. Sixteen raised roads, varying in length from a few miles to 62½ miles (the length of the Yaxuná-Cobá road) terminate within the great body of ruins about the chain of lakes. Mr. Harry E. D. Pollock, of the Institution staff, has visited Cobá three times to study the ruins, and says it is highly improbable that work of such magnitude and representing such organized effort could have been accomplished in a late and decadent period of Maya history. His study of the architectural features of the Cobá ruins discloses evidence of two periods of construction, to the earlier of which belong the great majority of the structures; also, that the workers of the time had all the technical skill and knowledge which road construction demanded. In the absence of evidence to the contrary, he concludes that it is best to consider the *sacbeob* as having been roughly contemporaneous with the structures of the earlier period.

One cannot be too sure of dates when dealing with

Maya history, but there is much evidence to support the statement that at the middle of the fourth century A.D. the Cobá region was occupied by an organized and established people who were capable of building great causeways. It is probable that they were begun during this century and completed before the end of the seventh. Why they were built is another mystery. The Maya had no beasts of burden, as had the road-building Inca of Peru; nor wheeled vehicles, as had the Romans, the greatest road builders of ancient times; yet, in durability, in evidence of careful workmanship, and in prodigious expenditure of labour on construction and upkeep, the roads of Cobá must have compared favourably with those of both.

Apparently these highways were built for travellers afoot and for men bearing palanquins and carrying burdens upon their backs. If so, and if these sixteen known roads were utilized to capacity, what an amazing picture of the activity of that day and region the imagination presents! Four files of men with their loads could easily pass, so wide were the roads, two lines going in one direction and two in the other.

Road building calls for organized community action of a relatively high order. Savage man builds no roads nor has he conscious need for them. When, however, mankind advances to the settlement-forming stage of civilization, the hunter's trail becomes inadequate and road-making begins. The magnificent causeways of Cobá testify eloquently to the fact that the Maya of that region and period, in possessing the capacity to plan and execute community projects calling for so great a degree of organizing ability, had come a long way along the path of civilization. They also indicate that Cobá, the focal point of all of these great roads, must have wielded a powerful influence in all matters touching the life of the people throughout a great area.

A Forgotten People.

It is strange, as well as disquieting that a people as numerous and as virile as the Cobá region contained could disappear; that their farms, their homes, their villages and cities, their temples, their great causeways, could be swallowed up by the jungle; and that their very existence, even, could be so nearly forgotten.

The discovery at Colchester of a series of Roman potters' kilns is among the most important finds of the past season. Although much has been written in this country about Roman pottery, the kilns themselves have seldom been studied.

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Book Reviews.

Here and There with Birds. By E. W. HENDY. (Cape. 7s. 6d.).

The chapters which go to make up this book are a series of essays on well-known birds which depend for their charm upon the literary skill of the author quite as much as upon original observation. Mr. Hendy has a gift for making a hackneyed subject absorbing and he writes with that knowledge and simplicity which only a true naturalist can attain. In this book he takes us to Norfolk and introduces us once more to the Broads, the Brecks, and the Heaths—and their feathered inhabitants. Then we are swiftly transported to far West Wales and are told of the charm of the Pembrokeshire coast, of the choughs and ravens, buzzards and peregrines which frequent its cliffs and of the sea-fowl which resort to the islets off its shores. A comparative account of Lundy Island in 1914 and Lundy in 1930 is delightful reading, and shows it to be a paradise for the ornithologist as well as for the sea-birds.

Chapters on the haunt of the kite, of Dartford warblers and hobbies, of the Sussex Downs and coast, and of Somerset in flood-time, are followed by a dissertation on the Elizabethan playwright, John Webster, whom Mr. Hendy considers to be the equal of Shakespeare in the accuracy of his ornithological knowledge: "None could interweave more cunningly than he the warp and weft of humanity and nature. His genius in tragedy commands our reverence; his understanding of nature compels our love."

Birds are, of course, the central theme, round which Mr. Hendy weaves his threads, but he has succeeded, where many would have failed, in bringing before us a picture of what still remains unspoilt in our islands, and of carrying his readers with him in the scenes which he depicts.

Though filled with a just horror of those who take pleasure in confining such a bird as a chough within a wire cage, Mr. Hendy writes without any trace of that sickening sentimentality which has done so much harm to the cause of bird protection. Incidentally he would, I think, be surprised at the important part played by the custodians of our National bird collection in the work of bird preservation.

On one subject the reviewer joins issue with the author. In his chapter entitled "Some Reflections" Mr. Hendy makes sweeping condemnation of those whom he loosely chooses to style "scientific ornithologists" when it is obvious from his statements that he is applying what should be (and is) an honoured term to some who have neither science nor sense. The true field-naturalist knows full well that he cannot get on without the "scientific ornithologist" just as the systematist realizes that he can make little headway without the aid of the observer in the field. The two are closely dependent on one another, and there are few systematists to have reached the front rank in this country who have not served their apprenticeship in the field, or who would not themselves endorse many of Mr. Hendy's "Reflections."

With the author's views on "senseless collecting" the writer is in full sympathy, but we must not entirely lose sight of the fact that many a boy (and girl also in these days) begin useful careers as ornithologists by making a small collection of skins or eggs. For those who collect for pecuniary gain there is no term too strong to apply and we thoroughly agree with Mr. Hendy that by far the best way to achieve protection is to educate the public—especially the younger generation—with a knowledge and love of birds. Mr. Hendy's books go far towards that end. His present contribution, like his *Wild Exmoor through the Year*,

is sure to be widely read, as it deserves, and assuredly will bring pleasure to his readers, for the spirit of the birds is in its pages. The book is illustrated with some excellent photographs and the index is sufficient.

British Beetles: Their Homes and Habits. Including Chapters on How to Identify, Collect and Study. By NORMAN H. JOY. (Warne. 5s.).

This abstract of Dr. Joy's large work is a highly condensed account of our 3,630 British beetles. It is one of the excellent Wayside and Woodland Series and should contribute much to the popularization of this group of insects which offers so attractive a field to the young naturalist. Species and individuals are so numerous that material for study may be found at all times and in all places: there is abundant scope for original work, and observation will be rewarded more rapidly than by the more popular butterflies and moths, and with few exceptions they offer no special difficulty in the way of preparation and preservation for the collection.

The instructions to beginners are useful, especially the hints on collecting, drawn from the author's long experience in the field, but the instructions for preparation are not so good. It is really a matter for personal taste whether or not *all* specimens should be carded, but it is a serious oversight to omit mention of the necessity of gumming some specimens of every species on the back, so that the underside may be examined with ease. The author tells us that a sweep-net may be obtained from any dealer. Dr. Joy has been lucky. We have never yet seen one that was of the slightest use, unless made at home in the light of experience. Where he tells the beginner (p. 15) that beetles always have six legs, the author might have usefully added that this is the chief feature that makes them insects, in contradistinction to spiders, for instance, which are so constantly regarded as insects in spite of their eight legs. In his fear of overloading his text with Latin and technical names, Dr. Joy has somewhat over-reached himself, for few laymen, we think, will understand what is meant by the English words *scape* and *scrobe*, neither of which are explained in the general account of the antennæ. He parries criticism by calling his arrangement of the sub-orders a key. In fairness to beginners, he should have made it clear that it is not a classification in the scientific sense. His attitude towards the problem of species is summed up in his expression of opinion, that "each of our beetles has been very carefully thought out to fulfil some purpose in the world."

The life history of some beetles offers us some of the most remarkable of the miracles of nature. That of *Meloe*, for instance, the oil beetle. All country folk know these large, blue-black, sluggish beetles with their soft, gaping elytra, which are often seen crawling about grassy places during the first sunny days of spring. The female deposits from two to four batches of tiny yellow eggs, some thousands at a time, in small holes dug in the ground by the parent beetle. A few weeks later thousands of active little larvæ are hatched, which run about the grass looking for bumble bees. A very small percentage finds one, and clings to its hairy body and so is carried into the nest, where it changes shape and lives on the bee's eggs and stores of food. There it lives, in three different forms, for two years, when it emerges as the oil beetle. The remarkable *Meloe* has a similar history, but lives in the nests of wasps as a parasite, eating the grubs carefully so as not to injure a vital organ until the grub is fully grown and seals its

cell for the change to the pupa, when the beetle finishes its dinner and turns into pupa itself.

The damage done by beetles is even greater than generally supposed. Two species of *Tenebrio* are a serious pest in granaries and flour mills; *Dermestes* is harmful to hides and leather and grocer's stores; *Xestobium*, the Death Watch, riddles the woodwork of ancient buildings; *Plinus* is the enemy of old clothes, carpets and sacks. At the same time some are the friends of mankind as our familiar glow-worm, which rivals the thrushes in keeping down snails in the garden; *Corynetes*, which is parasitic on the Death Watch, and the ladybirds which, especially in the larval stage, devour enormous quantities of plant-lice.

Makers of Astronomy. By HECTOR MACPHERSON. (Clarendon Press. 7s. 6d.).

Dr. Macpherson's learned and interesting book outlines the history of astronomy in a series of compact biographies of eminent astronomers from Copernicus to the great men of our own day like Kapteyn, Eddington and Shapley. Dr. Macpherson, himself an astronomer of distinction, is careful to explain simply and clearly what each man in the long roll of honour did to advance the science, and he adds greatly to the value of the book by summarizing the most recent theories of the universe and indicating how, as in the case of Kapteyn and Shapley, they can be reconciled where they appear to conflict. A competent review of this kind was very much needed by the layman, if only to remind him that a stupendous science like astronomy is built up slowly on the labours of generations, though the pace has quickened with the improvement in observing instruments and in methods of mathematical analysis. In Dr. Macpherson's pages one is told precisely why Newton's law of universal gravitation was supremely important, why Halley's discovery of his comet was epoch-making, how the elder Herschel improved the telescope and, with his son, catalogued the stars, how astrophysics was founded in Germany and developed in Italy, England and America, why Lowell's lifelong studies of Mars deserve attention, and so on. Special notice is given to the great Dutch and German astronomers of the last two generations, and to recent American work. Dr. Macpherson has not, of course, been able to mention all the prominent men, but his selection is judicious. Incidentally, he seems to show that astronomers are, as a class, long lived.

Earth-Lore. Geology without Jargon. By S. J. SHAND. (Murby. 5s.).

Professor Shand does not approve of the multiplication of technical terms, and he sets out to write in simple language an account of certain aspects of geology. But a scientific discussion involves more than words: it introduces conceptions concerning matters and principles of which the layman may have no previous knowledge, and it by no means follows that even if the language is simple, the discussion will be universally intelligible. This is especially the case with the facts and theories that are dealt with in this book, for they relate mostly to the major problems of geology—those concerning the structure of the earth and the behaviour of its crust—rather than to the details of the rocks, their contents and their uses. But conception as well as language is simple, although occasionally in his desire to avoid a technical name the author uses a "popular" synonym that is probably even less informative.

It would, for example, be better to allude to certain marine animals by their scientific name (brachiopod) and to explain it, than to call them "lamp shells"—a term with which not many laymen in these days are likely to be familiar.

In the opening pages we are introduced to an imaginary "Adamson—a rough, stupid fellow who finds himself on a great raft of earth floating into nothingness." At first his principal concern was food, but in time he began to notice and speculate upon "the things around him on the earth, and upon the moving points of light far away in the nothingness." Fortunately, however, the author soon forgets to carry on in this strain, and the "Conradian touch" disappears before the end of the second chapter.

Professor Shand gives us, in chapters entitled "The Age of the Earth," "What Lies Beneath the Crust?" and "Deeper and Deeper," excellent summaries of present knowledge and current beliefs concerning the structure and composition of the earth as a whole as revealed by the study of earthquakes and volcanoes, and he discusses the problems of mountain building and the development of the earth's larger surface features in chapters entitled "The Problem of Mountains," and "Rifts and Ramps." The last two chapters are devoted to the nature of the continental masses and the views (elaborated by Arthur Wegener who lost his life recently in Greenland) that their present shapes and positions are in large measure due to the fact that they have arisen from the breaking up and drifting apart of a land area that once comprised them all.

The perusal of this little book leaves one with a clear mental picture of the earth as modern geology reveals it; the student will find that it co-ordinates and correlates many of the facts he has learned, and the ordinary reader will find that it gives him as much information as he needs in language that he can understand.

The Adventurers of Bermuda. By HENRY WILKINSON. (Oxford University Press. 16s.).

The adventurers of whom Mr. Wilkinson writes in his scholarly work on Bermuda from 1609 to 1684 were the nobility and gentry and London merchants who ventured their money in the Somers Islands Company to establish and develop a new colony. Yet the enterprise had the romantic character suggested by the word "adventurer," and in this elaborately detailed account of its progress, based on research in the British and Spanish archives and on intimate local knowledge of Bermuda, Mr. Wilkinson fully justifies the premise of his title. The islands were probably discovered by and named after Juan Bermudez in 1511, and thereafter were dreaded by Spanish seamen as a danger zone which they passed on their homeward route from Havana to Spain. Sir George Somers, sailing in 1609 to relieve the newly-founded colony of Virginia, was wrecked on Bermuda, and the story, as told by William Strachey, secretary of the Virginia Company, excited great interest in England and inspired Shakespeare to write *The Tempest*. The company in 1612 obtained a new charter to include Bermuda in its sphere. Three years later Bermuda was entrusted to a separate company, most of whose directors and shareholders were identical with those of the Virginia Company, with the great Sir Thomas Smith, the pioneer in the East India, Levant and Russian trades, at the head of them.

Mr. Wilkinson's book is valuable because it relates not only the course of events in Bermuda but also the economic and political vicissitudes of the company at home. He describes,

in fact, the whole movement for trade and colonies which made the Stuart period memorable, and he shows how active a part was played by the Puritan leaders like Warwick, Sandys and Pym, always closely in touch with the moneyed interest of the City, in these American and West Indian ventures. Spain, as he shows from the Seville archives, watched these proceedings with angry suspicion but, fortunately for the infant colonies, never felt able to destroy them, though she crushed an audacious attempt to colonize an island near Jamaica which Pym and his associates rechristened Providence. Bermuda was colonized on a definite plan, divided up into "tribes" and holdings according to the principal shareholders, and peopled with a fair selection of decent yeomen as well as with ne'er-do-wells from the London slums. The colony depended at first mainly on its tobacco crop and suffered from the fall in price that followed over-production. When the West Indian colonies began to grow sugar with the help of slaves, Bermuda found it profitable to grow foodstuffs for them and thus achieved a modest prosperity.

The colony had the usual experience of local feuds between the Governor and the inhabitants, and there were endless complaints against the Company. But it is clear from the narrative that the shareholders can have made little profit on their venture, and that but for their capital and their influence the colony would have come to a speedy end. When Charles II cancelled the charter in 1684, the colony could stand alone. The history of the Chartered Company in our own day supplies an interesting modern parallel of which we are often reminded in this admirable study of the Somers Islands Company. Bermuda as a naval station and a health resort has fully justified the hopes of the public-spirited pioneers who secured it for England three centuries ago.

Mimicry. By G. D. HALE CARPENTER. With a Section on Its Genetic Aspect by E. B. FORD. (Methuen. 3s. 6d.).

For forty years Professor Poulton has advanced the claims of mimicry. At first regarded as an ingenious hypothesis, then as an interesting hobby, mimicry has now successfully taken its place as an integral part of the machinery of evolution. Although the co-ordination has been so patiently and skilfully conducted at Oxford, the theory of mimicry is essentially the work of the man in the field, and it is this outstanding fact that baffles the arm-chair critics. It was in the valley of the Amazon that Bates first put forward his hypothesis just over seventy years ago; it was from the Malay Archipelago that Wallace made his contribution a few years later; and in 1869 Trimen came forward with his African material. All this was Batesian mimicry, the key-word of which is deceit. In 1879 Fritz Muller, working like Bates on South American butterflies, drew attention to certain other phenomena, thus giving us Mullerian mimicry, the key-word of which is advertisement. True, reciprocal mimicry, Dixey's contribution in 1894, is of academic origin, but the field tradition reaches its logical conclusion in the succession to what may be termed the Chair of Mimicry at Oxford by Dr. Hale Carpenter, who won his laurels in East Africa. It is appropriate that the new professor, thus combining the field with the study, should be the first to give us in compact form a handbook of the theory, the literature of which is scattered through an extensive list of publications.

It is instructive to note that out of the list of fifty authors quoted, all except six wrote in English. Mimicry is essentially a British science which has never been fully understood by

European entomologists. The very term itself is generally misconstrued, for *Mimikry*, *Mimetismus*, *Mimetisme*, are constantly misapplied by continental authors to the resemblance of creatures to their environment, a totally distinct phenomenon, technically termed *Procrispis*. Another widespread misconception is that mimicry occurs only in butterflies. It is highly developed in many other orders of insects, especially in the Diptera, Coleoptera and Hymenoptera, as might be expected from the immense scope offered by creatures of such unlimited variety and universal abundance. The most astonishing case is in the seed of flax, and the most familiar that of the cuckoo's egg, a clear instance of Batesian mimicry deceiving the selective-agents, i.e., the foster-parents. The last chapter is an extremely interesting essay on the difficult and obscure subject of the genetics of mimicry.

Our Forefathers. Vol. II. By GUDMUND SCHUTTE. (Cambridge University Press. 30s.).

For readers who may not have read the first volume of this monumental work, published some three years ago, it may be explained that it deals with the ethnography of the Germanic peoples, or as the author would prefer, the Gothonic nations—Gothic, German, Dutch, Anglo-Saxon, Frisian and Scandinavian. It covers in the main the pre- and proto-historic periods, for later ages reference being made to standard authorities. The first volume dealt with general considerations relating to the Indo-Germanic groups and the Gothonic peoples as a whole. In this volume each of these peoples is considered in turn under the grouping Gothic, German-Dutch, North-West Gothonic, which includes the Anglo-Saxons, the Peninsula, including the Jutes, and the Scandinavian. In each of these groups, all available evidence is set out, naturally much condensed, on an identical plan. First comes an analysis of the evidence of the names by which the group or tribe has been known, then its sub-divisions, its ethnic position, its history and, finally, its legendary traditions. The material thus analysed is drawn from literary and historical references, archaeology, philology, ethnology and folklore.

Dr. Schutte regards his work as no more than a sketch of the lines on which an ethnography of the Gothonic peoples should be written. As it stands, however, it is an invaluable aid to the study of the archaeology and racial history of the Germanic peoples in the later prehistoric and early historic periods. It has this much of topical interest, that even a glance at its various sections should carry conviction of the futility of the loose notions relating to race and racial purity now fashionable in certain quarters.

Brazilian Adventure. By PETER FLEMING. (Cape. 12s. 6d.)

This is the narrative of a journey made down the river Araguaya last summer by a party of seven young men. It was not the sort of venture of which accounts appear subsequently in the chronicles of Royal societies, with learned appendices on the scientific investigations. As a geographical expedition it was grotesquely unprofessional and in the ordinary course of events it would be hard to find an excuse for a book about it. But as it happens there was among them an experienced and even brilliant writer who was taking a holiday from the literary editorship of one of the most august of our weekly journals. Any book by Mr. Fleming should always be well worth reading.

From the headwaters of the Tapirapé the author struck

across country with one companion to attempt to clear up the mystery surrounding the fate of Colonel Fawcett who in 1925, as recorded in articles in *Discovery*, disappeared in those regions with his son and another youth. The journey did little to solve the Fawcett problem for the expedition had been much delayed by the Brazilian temperament and an annual revolution. By the time they reached the scene of operation the rains were imminent and Mr. Fleming's effort was little more than a gesture of determination. It did, however, prove the hardships of travelling through that region and the difficulties of procuring food and water, and it established the fact that Fawcett's party in the condition in which it was last seen, worn out and with two men lame, could scarcely have survived one month—let alone the eight years that they have been missing.

To a critic who has himself explored in tropical forest and who reads a large number of the books in this class *Brazilian Adventure* is of special merit, if only for one reason. Mr. Fleming writes with strict veracity and, if anything, a tendency to understate. Almost all the authors who describe the interior of Brazil make great play with the terrors of the jungle. But the heat, the insects, the danger from cannibals, lurking alligators and prowling jaguars are all classed together by Mr. Fleming as "the paraphernalia of tropical mumbo jumbo."

The Nidification of the Birds of the Indian Empire. Vol. II.
By E. C. STUART BAKER. (Taylor & Francis. 21s.).

This work is a comprehensive, up-to-date account of the breeding habits of the birds of the Indian Empire. Vol. I dealt with the first half of the large Passerine order; Vol. II completes the Passeres. Twelve families are dealt with in the volume under review. They include the thrushes, flycatchers, shrikes, cuckoo-shrikes, swallow-shrikes, king crows, warblers, gold crests, fairy blue birds, orioles, grackles and starlings. Altogether the breeding of 403 species and subspecies is described out of 465 kinds believed to breed within our area. From these figures it will be realized that our knowledge of the breeding of Indian birds is now far advanced.

Much progress has been made since the issue of A. O. Hume's "Nests and Eggs of Indian Birds" in 1890. Mr. Baker was himself responsible for a large number of the more recent discoveries, especially in the rich Assam field. Many other ornithologists have helped to fill up the gaps in our knowledge in other localities, and Mr. Baker has made full use of all available literature on the subject.

The nomenclature, which is trinomial, the serial arrangement and the numbering of species and subspecies agree with that adopted in the revised edition of the "Fauna of India," and this will greatly facilitate references. Breeding localities are enumerated and described, and detailed descriptions are given of the nests and materials used in their construction, the characteristics of the eggs as regards shape, colour gloss and size, accurate measurements being given in millimetres.

A few points should be mentioned in criticism or in pointing out errata. On page 73, line 23, the word "mani" is followed by "boundary of a field" in brackets, presumably as explanatory. This is incorrect. The walls constituting the boundaries of fields are used only in connexion with terraced cultivation and have nothing whatever to do with mani walls, which are sacred constructions, often of immense size, built by the Buddhist monks from time immemorial and covered with stones engraved with the mystic words *om mani padmi humi*. On page 108, line 3, for "North-east Frontier" read

"North-west Frontier." On page 235, line 33, the paradise flycatcher does not breed in Naini Tal, which is at an elevation between 6,200 and 7,000 feet above sea level. They breed in the valleys below up to about 5,000 feet, where also Mr. Whympers house and garden were situated. On page 346, line 19, the distribution of *Dissemurus paradiseis grandis*, quoted from the fauna in "The Himalayas from Mussoorie to Eastern Assam" is misleading. The bird is not to be found in the Himalayas, at any rate in the Western Himalayas. It is essentially a bird of the submontane tract, the so-called Bhabar and Tarai forests east of the Ganges. On page 353, line 3, of the vast majority of the great reed warblers breeding in Kashmir, probably 999 out of 1,000 breed in the valley lakes, about 5,200 feet. Higher breeding grounds are quite exceptional. On page 385, line 37, "khydia" should read "kydia"; on page 458, line 5, "between 18 and 24 feet," for feet read "inches"; on page 116, line 16, for "Dinsur" read "Binsar"; on page 160, line 38, for "Binsea" read "Binsar"; here and elsewhere, for "kuman" read "kumaon," which is the correct and officially accepted spelling of the Civil Division referred to; on page 189, line 3 from bottom, and page 190, line 10, for "Tiderwat" read "Liderwat"; on page 217, bottom line, for "Dunajiri" read "Dunagiri."

The volume is provided with a good index and several excellent plates (photographs by Bates), and will be welcomed by all bird-lovers in India.

The Werewolf. By MONTAGUE SUMMERS. (Kegan Paul. 15s.).

It is widely believed among primitive peoples throughout the world that a man possessing certain powers may change his shape and assume that of an animal, usually fierce and hostile to man. Lions, tigers, hyenas and jaguars are favourite forms. So far as there is any record, this belief is of great antiquity. In West Africa it was the mainstay of the power, and a cloak for the atrocities of the notorious Leopard secret societies. Their object was discipline through murder, effected in such a way as to simulate an attack by a leopard. In Europe the change was usually into the form of a wolf, the werewolf or man-wolf, although among the northern races the animal was more frequently a bear. In the British Isles witches were held to be able to transform themselves into hares and cats, and while in this shape they could be shot only with a silver bullet.

In Europe the belief that men changed into wolves was recorded by Herodotus, and it has survived down to modern times, especially in eastern Europe, where it is closely connected with the vampire belief, and among the peasantry of France. The Russian peasants believe that Lenin spent part of his life as a bear. In mediaeval Europe the change in shape linked the witch with the werewolf, while the purpose of the metamorphosis, being to attack human beings and devour their flesh, associated the werewolf with the vampire. Like the witch, the werewolf was believed to derive his power from a pact with the devil.

In this volume, which Mr. Summers has now added to his studies of witchcraft and allied magical beliefs, attention is confined to Europe. The anthropological point of view is deliberately set aside in favour of the theological. This precludes anything like a scientific study of the problem; but none the less the author's wide knowledge of the mediaeval literature gives the volume its value for the student. His attitude towards the werewolf belief, however, shows an orthodox acceptance of authority in these matters that is rare and, in these days of scientific research, incongruous.

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